FORECAST-REVIEW ISSUE

FORECAST 1961

REVIEW 1960

THE INDUSTRY'S STANDARD

THE UNIVERSITY OF MICHIGAN
FEB 27 1961
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What's new in drilling? 63
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FEBRUARY 15
1961

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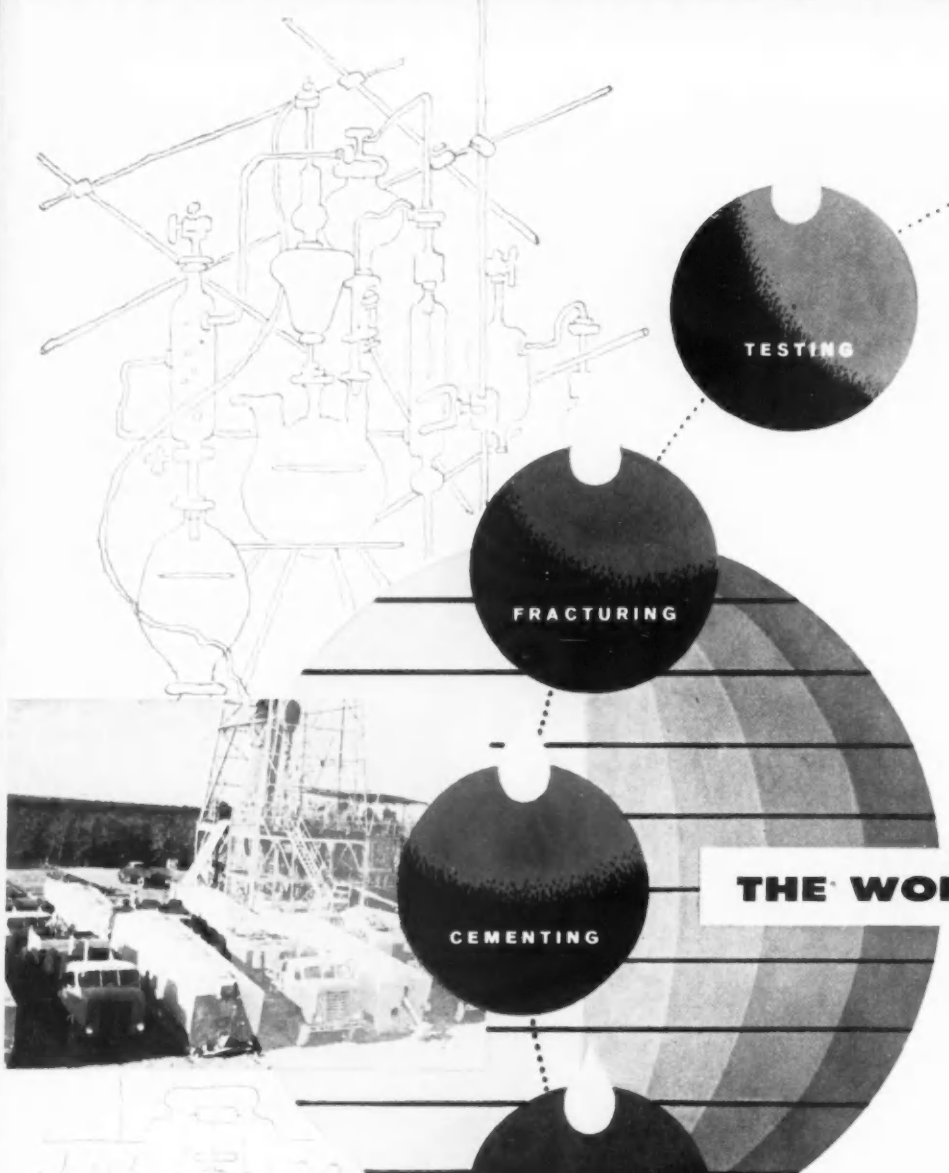

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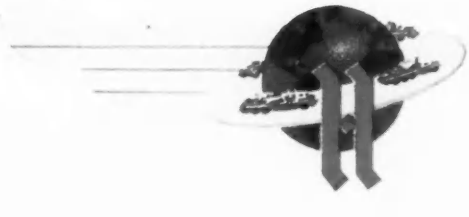

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WORLD OIL

Volume 152, No. 3 February 15, 1961

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CHANGING PANORAMA 1960-1961

A Quick Look At This Forecast-Review Issue, The Industry's Standard

THE SITUATION of the petroleum industry improved materially in the latter half of 1960. Better markets and prices were the reward for reducing oil surpluses and more closely balancing supply with demand.

For 1961 the outlook is the best that has existed for some time. Prices of products promise to remain at more profitable levels, and the crude oil markets are becoming firmer.

Demand for petroleum continues to increase moderately, and some expansion of industry operations will be justified. However, troublesome surpluses of recent years are fresh memories, and the industry is in a mood to practice moderation in drilling, production, and refining activities.

Articles in this annual Forecast-Review Issue give a comprehensive view of the industry's prospects, as well as its current and recent experience. Here are concise summaries of the articles.

More production required to meet increased demand. U.S. oil producers in 1961 will have a market for 7,210,000 bpd of crude and 967,000 bpd of natural gas liquids. Needed output will exceed 1960 by 190,000 and 36,000 bpd, as demand increases..... Page 59

Continued on Page 5

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Controls expected to stop rise of imports. Controls of past three years have succeeded in slowing the increase in U.S. oil imports. A slight reduction from last year's record imports is foreseen for 1961.....**Page 61**

Crude oil prices gradually improving from low of 1959. Producers hope for further recovery, as product prices are now better. Average price of $2.92 per barrel in 1960 was 2 cents above 1959 but 17 cents or 5.5 percent under the peak of $3.09 reached in 1957..**Page 62**

What's new in the drilling industry? Although no radical changes occurred last year in drilling technology, several new types of equipment and improved practices emerged. They are assisting drilling contractors' efforts to compete in an industry besieged by mounting costs. Some of these improvements were observed in the circulating mediums, new rig designs, new and improved drilling tools/equipment and changes in past drilling practices.....**Page 63**

Drop in U.S. drilling in 1961 forecast. WORLD OIL forecasts the drilling of 46,079 new wells in the United States in 1961, a drop of 1.5 percent or 699 wells from 1960. The 46,778 new wells completed in 1960 represented a decrease of 3,401 wells or 6.8 percent from the 50,179 of 1959. The 46,079 completions predicted for 1961 would be a new low since 1951 and a decline of 12,339 wells or 21.1 percent from the record of 58,418 wells completed in 1956.....**Page 69**

U.S. rig activity down 11.2 percent. Declining to an 18-year low, an average of 3,543 rigs operated monthly during 1960, or 448 fewer than in 1959. Texas reported the biggest drop averaging 849 rigs per month, down 187 from 1959. The only states reporting significant gains were West Virginia, Indiana, Michigan and Colorado .....**Page 71**

New world's depth record in 1961? John W. Mecom is now drilling below 12,000 feet in a test to 26,000 feet in Louisiana's Lake Washington field. If projected depth is reached, the well will replace the West Texas record holder at 25,340 feet. One 20,000-foot well was drilled during 1960 and four areas set drilling depth records .....**Page 72**

Advancements in production methods—1960. A number of new production tools and techniques were introduced or became operational last year. This article discusses achievements in tubingless and conventional well completions, logging and perforating, well stimulation, lease production installations, artificial lift and workover operations.....**Page 74**

Continued on Page 7

Salient Statistics: Forecasts for 1961, and Review, 1960 vs. 1959

Units—Oils: thous. bbls. daily, except stocks in thous. bbls. Natural gas: billion cu. ft. Wells and fields: number. Footage: thousand feet.

ITEM (units shown above)	1959	1960	% Diff. 1959-1960	1961 Forecast	% Diff. 1960-1961
SUPPLY					
Production	**7,933**	**7,951**	**+ 0.2**	**8,177**	**+ 2.8**
Crude Oil	7,054	7,020	— 0.5	7,210	+ 2.7
Value at Well $ Per Bbl.	2.90	2.92	+ 0.7	*2.93	+ 0.3
Other Oils	879	931	+ 5.9	967	+ 3.9
Imports	**1,780**	**1,816**	**+ 2.0**	**1,806**	**— 0.6**
Crude Oil	966	1,028	+ 6.4	1,023	— 0.5
Products	814	788	— 3.2	783	— 0.6
New Supply	9,712	9,767	+ 0.6	9,983	+ 2.2
Stock Change	**+53**	**—122**	.....	**—71**	.....
Crude Oil	—15	—62	.....	.....	.....
Other Oils	+68	—60	.....	—71	.....
DEMAND					
Total Demand	**9,662**	**9,889**	**+ 2.3**	**10,054**	**+ 1.7**
Gasoline	4,112	4,182	+ 1.7	4,270	+ 2.1
Kerosine	304	365	+20.1	398	+ 9.0
Distillate	1,843	1,907	+ 3.5	1,934	+ 1.4
Residual	1,602	1,580	— 1.4	1,551	— 1.8
All Others	1,801	1,855	+ 3.0	1,901	+ 2.5
Exports	**240**	**204**	**—15.0**	**195**	**— 4.4**
Crude Oil	7	7	.....	5	—28.6
Products	233	197	—15.5	190	— 3.6
Domestic Demand	**9,422**	**9,685**	**+ 2.8**	**9,859**	**+ 1.8**
Gasoline	4,055	4,142	+ 2.1	4,231	+ 2.1
Kerosine	301	363	+20.6	395	+ 8.8
Distillate	1,807	1,877	+ 3.9	1,904	+ 1.4
Residual	1,531	1,528	— 0.2	1,501	— 1.8
All Others	1,728	1,775	+ 2.7	1,828	+ 3.0
Runs to Stills	**7,994**	**8,079**	**+ 1.1**	**8,204**	**+ 1.5**
Stocks, Year End	**808,042**	**789,300**	**— 2.3**	**763,385**	**— 3.3**
Crude Oil	257,129	238,700	— 7.2	238,700	.....
Nat. Gas Liquids	24,887	30,000	+20.5	524,685	— 4.7
Refined Products	526,026	520,600	— 1.0		
Gasoline	187,115	196,900	+ 5.2	.....	.....
Kersoine	26,817	31,700	+18.2	.....	.....
Distillate	151,030	140,200	— 7.2	.....	.....
Residual	53,261	45,800	—14.0	.....	.....
Others	107,803	106,000	— 1.7	.....	.....
Wildcats Drilled	**9,907**	**9,103**	**— 8.1**	**8,917**	**— 2.0**
Dry	8,828	8,222	— 6.9	.....	.....
Productive	1,079	881	—18.4	.....	.....
Oil	713	564	—20.9	.....	.....
Distillate	85	71	—16.5	.....	.....
Gas	281	246	—12.5	.....	.....
Wells Completed, Totals	**50,660**	**47,175**	**— 6.9**	.....	.....
New Wells	50,179	46,778	— 6.8	46,079	— 1.5
Oil	25,532	22,233	—12.9	21,777	— 2.1
Distillate	800	750	— 6.3	5,930	+15.6
Gas	4,070	4,379	+ 7.6		
Dry	18,669	18,185	— 2.6	18,372	— 5.4
Service	1,108	1,231	+11.1		
Wells Deepened	481	397	—17.5	.....	.....
Footage Drilled, Thousand Feet	**206,782**	**195,022**	**— 5.7**	.....	.....
New Wells	206,199	194,583	— 5.6	191,326	— 1.7
Development	157,489	149,645	— 5.0	.....	.....
Wildcats	48,710	44,938	— 7.8	.....	.....
Old Wells	510	439	—13.9	.....	.....
Wells Drilling, Yr. End	**3,894**	**3,511**	**— 9.8**	.....	.....
Monthly Avg.	3,991	3,543	—11.2	.....	.....
Oil Wells Producing, Yr. End	**589,533**	**599,977**	**+ 1.8**	.....	.....
Artificial Lift	520,919	532,710	+ 2.3	.....	.....
Flowing	68,614	67,267	— 2.0	.....	.....
Gas Wells Producing, Yr. End	**86,256**	**94,617**	**+ 9.7**	.....	.....
Dry Gas	77,006	84,570	+ 9.8	.....	.....
Condensate	9,250	10,047	+ 8.6	.....	.....

* Price in January, 1961.

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THE CHANGING PANORAMA—1960-1961

U.S. crude production to set new record in 1961. Estimated output of 7.2 million bpd would be increase of 188,000 bpd or 2.7 percent over output in 1960. It also would exceed previous peak of 7,140,000 bpd in 1957 by 40,000 bpd. Production was off 32,000 bpd or 0.5 percent in 1960 to permit reduction of surplus stocks of crude and products.....**Page 81**

Slight decrease in artificial lift is forecast. Some 23,141 wells are expected to require pumping or gas lift equipment in 1961, or 523 fewer than in 1960. Most of these wells will require new equipment although some will utilize materials from abandoned wells .....**Page 82**

Number of producing oil wells at new high. Total for United States rose to peak of 599,977 at the end of 1960 from 589,533 at the close of 1959. Crude production remained below previous peaks, however; and output per well was down to 11.8 bpd, or near the lowest levels of the post war period.....**Page 83**

Producing gas wells increase sharply. U.S. total of 94,617 gas and gas-condensate wells on production at end of 1960 was a new peak. It was an increase of 8,361 over the end of 1959. Gas well completions increased in 1960 in the face of sharp curtailment of oil well completions.....**Page 84**

Eleven U.S. areas have new producing depth records. South Louisiana still is the locale of the world's deepest producing well, even though the previous record holder was plugged back to a shallower depth last year. Deepest producer now is R. F. Price 1, producing from Miocene at 20,186 feet in Plaquemines Parish's Lake Washington field.....**Page 85**

Exploration Outlook 1961. Exploration will be active in 1961 in the United States and Canada. Geologists in all oil and gas prospective areas have been surveyed, and their views are published in this issue.

Exploratory activity is to remain vigorous, although trend plays are generally keyed to markets, and prospects and costs are being scrutinized cautiously. The heaviest activity is expected in east and north Texas, Louisiana, Mississippi, Oklahoma, the Williston Basin, the Paradox Basin and Sacramento Valley...**Page 87**

Less than 9,000 wildcats in 1961. WORLD OIL forecasts 8,917 wildcats will be drilled in the United States during 1961, the first time in 11 years that the total has dropped below 9,000 wells. Texas will account for 35.2 percent of the total, compared with 36.2 percent in 1959 and 44.1 percent during the peak wildcatting year of 1956.....**Page 98**

Liquid hydrocarbon reserves in U.S. are at new high. More than 50,000 wells per year must be drilled to maintain reserves equal to 13 years of production, as heretofore. Recent success has been dimmed by emphasis on development rather than exploratory drilling .....**Page 100**

U.S. gas reserves increase despite growing consumption. Substantial development of new reserves is causing net additions to the reserves despite large consumption. But the ratio of reserves to annual production steadily declines and now is at a record low .....**Page 104**

Decrease in drilling foreseen for Western Canada in 1961. WORLD OIL forecasts 2,425 wells and 13.2 million feet of hole will be drilled in Western Canada during 1961, down slightly from 1960. However, recent government action on natural gas exports, and hoped for action on pressing crude oil problems, has improved Canada's long range drilling prospects considerably .....**Page 106**

Drilling rise due in Free World outside U.S.-Canada. About 6,081 well completions in 1961 are forecast. That would be an increase of 379 wells or 6.6 percent over the 5,702 completed in 1960. There had been 5,043 new wells finished outside the United States and Canada in 1959.....**Page 108**

World crude production to climb again in 1961. It is expected to increase by 1,159,279 bpd or 5.5 percent to a new record of 22,051,000 bpd. In 1960 it rose 1,411,506 bpd or 7.2 percent to 20,891,721 bpd from 19,480,215 in 1959. A slight increase is expected in the United States, but the U.S. part of the world total is to drop further from 36.2 percent in 1959 and 33.6 percent in 1960 to 32.7 percent this year. Crude oil output continues to climb strongly in Argentina, Russia, Algeria, and the Middle East. Libya and the Philippines may enter commercial crude production this year.....**Page 111**

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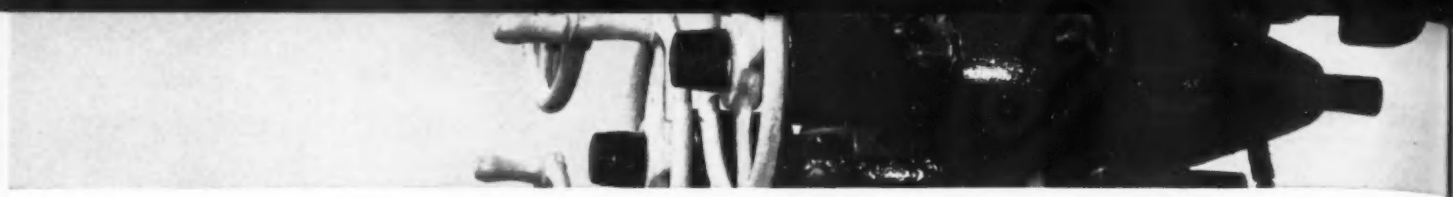

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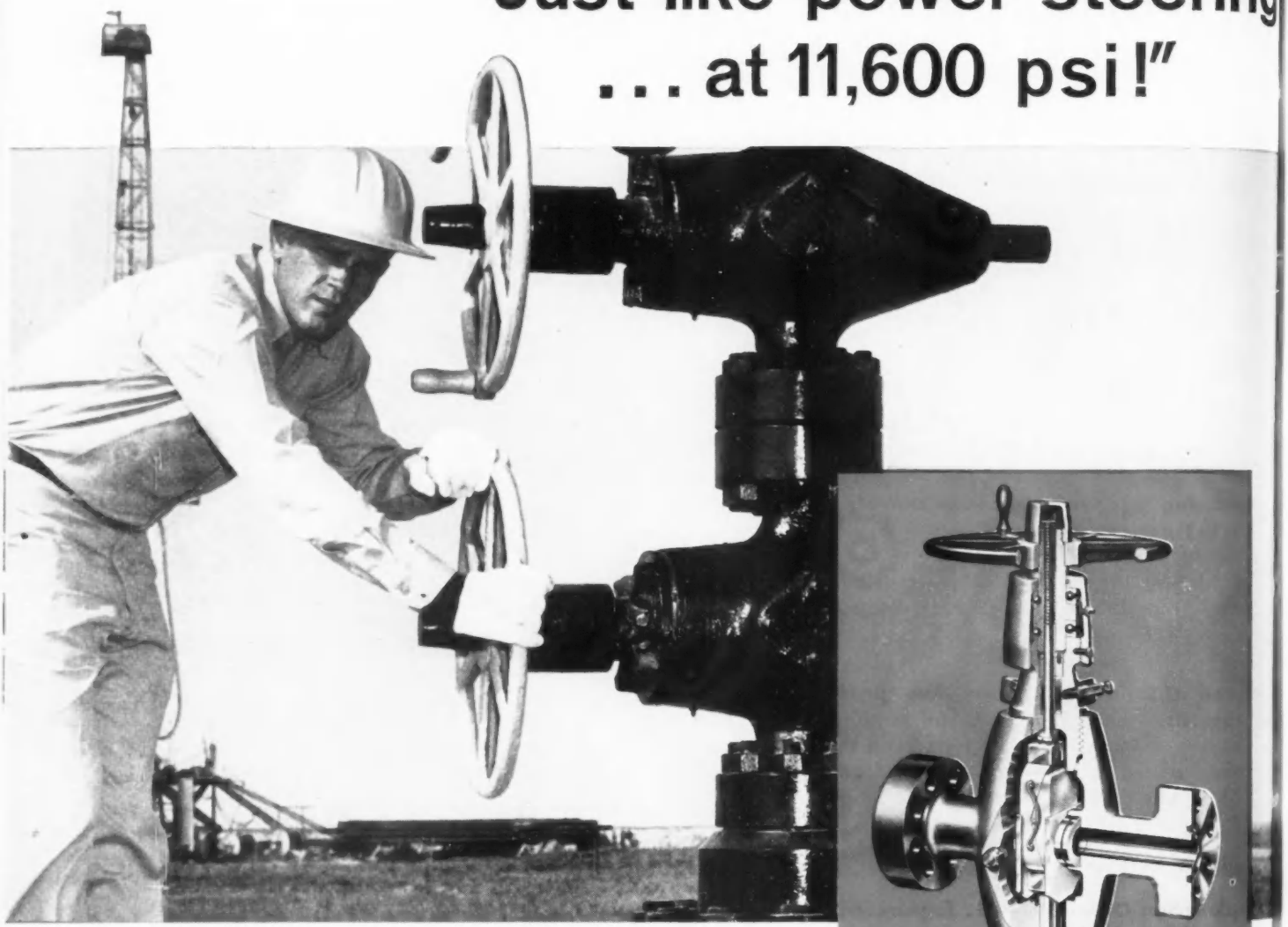

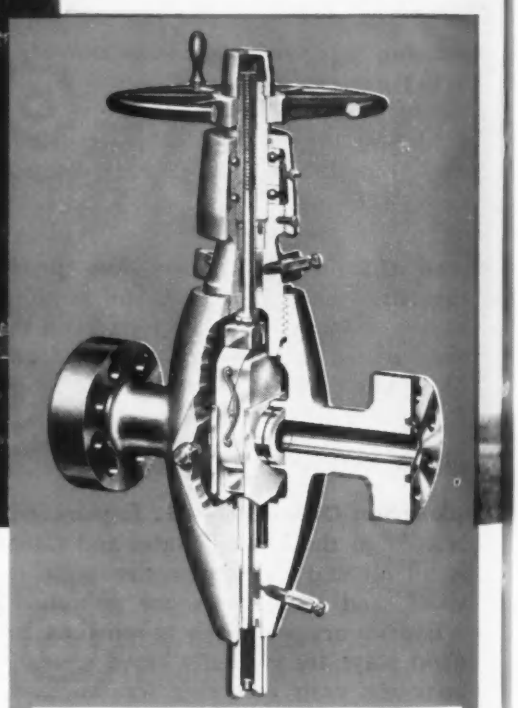

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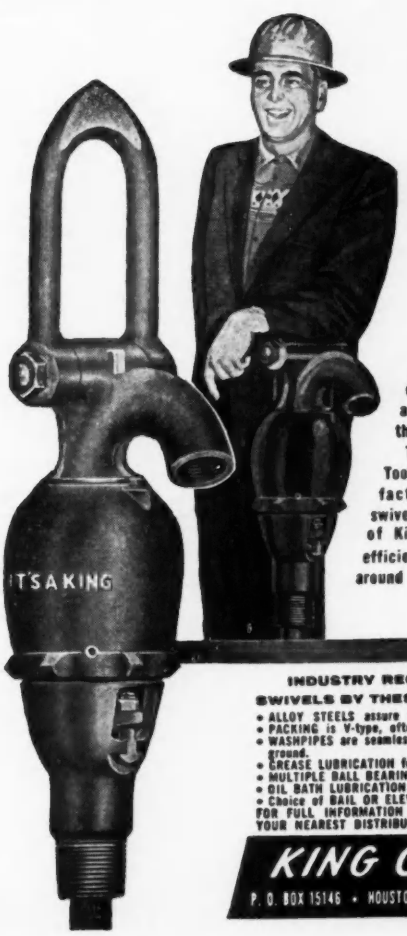

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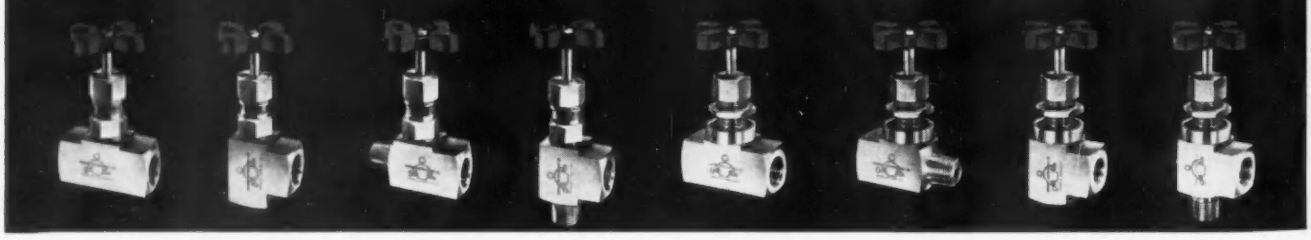


What happened to whale oil, horses and wood?

COAL AND WOOD provided enough heat and industrial fuel, but they required bulky furnaces and transformed cities into a dirty, soot-laden mess. Winter was a season of dread because it meant clinkers, ashes and getting up on cold mornings to put more coal or wood into the furnace.

The horses were painfully slow and provided uncomfortable transportation, particularly on cold, wintry days. Whale oil and coal oil didn't give much light, and smelled terrible.

But, that was all we had in 1850.

Those may have been the "good old days," but who wants to trade their new car, electric lights, and oil or gas furnaces to relive them? Certainly no member of the U.S. Supreme Court, National Coal Policy Conference or Congress. Nor would the Kennedy Administration.

However, judging from recent actions, some of these groups would put serious obstacles in the path of the economic freedoms that made possible the transportation, lighting and fuels conveniences of today. And hold back progress toward even greater conveniences tomorrow.

For example:

In its recent ruling in the Transco-Consolidated Edison case, the U.S. Supreme Court decreed that the Federal Power Commission could control the "end use" of natural gas by refusing to allow it to be purchased at the wellhead for use as a boiler fuel—even though it would have been much more efficient, and would have curbed pollution in the area where it was to be used.

President Kennedy has publicly advocated a national fuels policy study which many justifiably believe may result in strict end use controls.

In recent testimony submitted to a subcommittee of the Senate Banking and Currency Committee, National Coal Policy Conference President Joseph E. Moody said there is an urgent need to increase the nation's coal consumption 100 million tons a year to relieve unemployment in coal producing areas. This can be accomplished in part, he claims, by reducing "excessive" residual imports now replacing more than 50 million tons of coal annually, and by eliminating the "dumping" of natural gas under steam boilers.

All of the above actions have been created, or are being requested, by the coal industry. To solve an unemployment problem brought about by progress, coal's leaders would increase federal control of industry, eliminate consumers' choice of the fuel they prefer to use, and seriously impede the economy of oil and gas producing areas for the sake of coal areas.

These are radical actions that coal is advocating. Actions that can change this nation's entire policy toward free enterprise.

Before the wails of coal push industry completely under federal control, these three things should be considered.

1. Federal government did not step in to protect employment in the whaling and coal oil industries when electricity became available to the consumer, nor did it protect the livery stables when automobiles came on the scene, nor did it protect the coal and timber industries when oil and gas first came into use.

As a result, free competition created the most rapid technological progress in history. What will happen when fuel cells, solar energy and atomic energy become available to the consumer? Will he be told what he can use so that employment can be maintained in the oil, gas and coal industries?

2. In 1952, the President's Materials Policy Commission, after months of study, expressed this view in suggesting a national fuels policy:

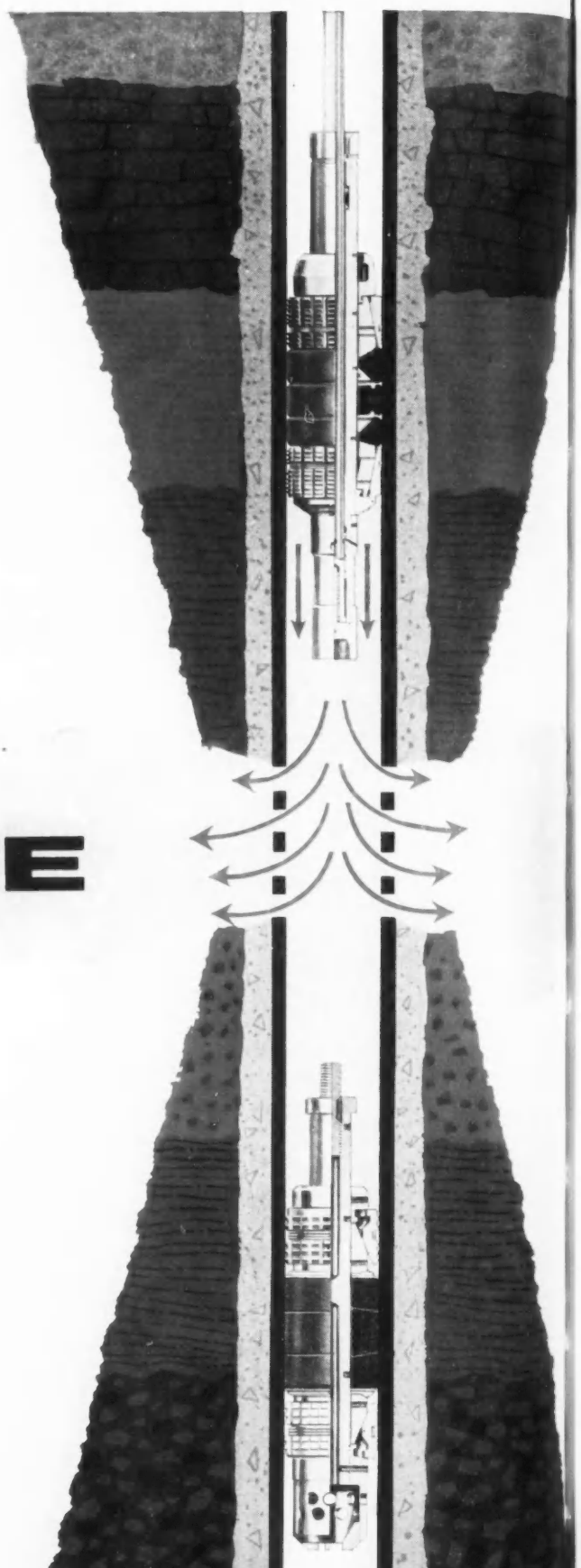
"Conservation is something very different from simply leaving coal in the ground or trees in the forests on the theory that by sacrificing lower value uses today we will leave something for the higher value uses of tomorrow when supplies will be scarcer. Using resources today is an essential part of making our economy grow . . . Technological changes and new resource discoveries may alter a situation completely."

In short, why refrain from using natural gas under boilers today, if our grandchildren will not know what to do with it tomorrow?

3. Our economic freedoms include freedom of consumer choice, freedom of occupational choice, freedom to consume or save and invest, to own property, and freedom of enterprise. No man can be completely free if he is denied consumer sovereignty. Without this economic freedom, we are not a free nation.

We are enjoying the benefits of free enterprise as it existed in the 1800s. It is our responsibility to do the same for the consumers of 2000.

HALLIBURTON PUTS THE SQUEEZE ON DOWNHOLE CEMENTING PROBLEMS



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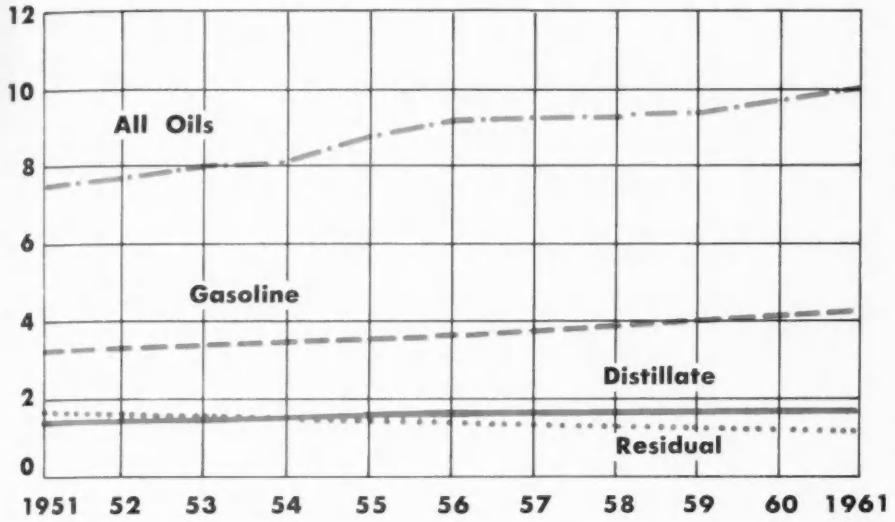
TOTAL DEMAND FOR ALL OILS AND PRINCIPAL PRODUCTS STEADILY INCREASING

(Millions of Barrels Daily)



A World Oil Chart

More production required to meet increased demand

U.S. OIL PRODUCERS will have a moderately better demand for their production in 1961. They had virtually no improvement in their market in 1960. The betterment in 1961 will be gradual.

Production of crude oil and natural gas liquids will be up less than 1 percent in the first quarter. But then there will be gains of 2.4 percent in the second quarter, 3.7 percent in the third quarter, and 4.5 percent in the fourth quarter. For the year as a whole, the increase will be 2.8 percent over 1960.

These are the forecasts of the U.S. Bureau of Mines. They are based on estimates of demand for petroleum products as shown in the table herewith. In making the demand estimates, the bureau anticipated that general business activity would improve in the third quarter of 1961. It also assumed that weather conditions would be normal.

In determining the volumes of domestic production to be required, the bureau estimated that imports of crude oil and products would be about the same in 1961 as in 1960. It also assumed no net change in crude oil stocks for the year.

The total demand for all oils in 1961 can be met, the bureau concluded, from crude runs to stills of 8,204,000 barrels daily and a 71,000 barrel daily reduction in stocks of finished products. Such a stock withdrawal would total 26 million barrels. During 1960, crude stocks were reduced by 62,000 barrels daily and product stocks by 60,000 bpd.

The expected 2.8 percent increase in 1961 in requirements for domestic production is a somewhat better gain than that of 1.7 percent forecast for total demand for all oils. This advantage for the producer will arise from a slight decrease in imports and the inability to draw materially, as in 1960, on crude stocks, which are now near minimum working requirements.

The expected 2.8 percent increase in domestic production of all oils in 1961 will be a gain of 226,000 barrels daily, to 8,177,000 bpd from 7,951,000. The 1960 output was an increase of only 18,000 bpd or 2/10 of 1 percent. For crude oil the increase in 1961 will be 190,000 bpd or 2.7 percent, to 7,210,000 bpd from 7,020,000. Crude output in 1960 involved a decrease of 34,000 bpd or ½ of 1 percent.

Production of natural gas liquids in 1961 will be up 36,000 bpd or 3.9 percent to 967,000 bpd from 931,000.

U. S. Petroleum Supply and Demand

(Source: U. S. Bureau of Mines . . . Thousands of Barrels Daily.)

	SUPPLY				DEMAND		
YEAR	U.S. Prod. All Oils	Total Imports	Total New Supply	Change in Stocks All Oils	Domestic Demand	Exports and Shipments	Total Demand
1946.....	5,073	377	5,450	+119	4,912	419	5,331
1947.....	5,451	437	5,888	— 14	5,451	451	5,902
1948.....	5,921	514	6,435	+292	5,775	368	6,143
1949.....	5,477	645	6,122	— 8	5,803	327	6,130
1950.....	5,906	850	6,756	— 55	6,507	304	6,811
1951.....	6,720	844	7,564	+ 89	7,053	422	7,475
1952.....	6,868	952	7,820	+108	7,280	432	7,712
1953.....	7,113	1,034	8,147	+142	7,604	401	8,005
1954.....	7,035	1,052	8,087	— 29	7,760	355	8,115
1955.....	7,579	1,248	8,827	.....	8,459	368	8,827
1956.....	7,952	1,436	9,388	+179	8,779	430	9,209
1957.....	7,979	1,574	9,553	+167	8,818	568	9,386
1958.....	7,518	1,700	9,218	—140	9,083	276	9,358
1959.....	7,933	1,780	9,713	+ 51	9,422	240	9,662
1960.....	7,951	1,816	9,767	—122	9,685	204	9,889
1961 Est....	8,177	1,806	9,983	— 71	9,859	195	10,054

Supply and Demand for All Oils in the United States,[1] by Quarters, Showing 1960 and Forecast of 1961

(Thousand Barrels Daily)

	1st. QUARTER			2nd. QUARTER			3rd. QUARTER			4th. QUARTER			YEAR				
	1960	1961	% Up	1960	1961	% Up	1960	1961	% Up	1960[2]	1961	% Up	1959	1960[2]	% Up	1961	% Up
SUPPLY																	
Production	**8,153**	**8,220**	**0.8**	**7,849**	**8,035**	**2.4**	**7,842**	**8,135**	**3.7**	**7,960**	**8,315**	**4.5**	**7,933**	**7,951**	**0.2**	**8,177**	**2.8**
Crude Oil	7,199	7,240	0.6	6,941	7,095	2.2	6,923	7,191	3.9	7,018	7,312	4.2	7,054	7,020	— 0.5	7,210	2.7
Other Oils	954	980	2.7	908	940	3.5	919	944	2.7	942	1,003	6.5	879	931	5.9	967	3.9
Imports	**1,953**	**1,920**	**— 1.7**	**1,824**	**1,745**	**— 4.3**	**1,700**	**1,700**		**1,790**	**1,860**	**3.9**	**1,780**	**1,816**	**2.0**	**1,806**	**— 0.6**
Crude Oil	963	1,020	5.9	1,068	1,000	— 6.4	1,051	1,030	— 2.0	1,030	1,060	2.9	965	1,028	6.5	1,023	— 0.5
Products	990	900	— 9.1	756	745	— 1.5	649	670	3.2	760	800	5.3	815	788	— 3.3	783	— 0.6
New Supply	10,106	10,140	0.3	9,673	9,780	1.1	9,542	9,835	3.1	9,750	10,175	4.4	9,713	9,767	0.6	9,983	2.2
Stock Change	**—695**	**—685**		**+371**	**+345**		**+403**	**+420**		**—567**	**—375**		**51**	**—122**		**—71**	
Crude Oil	+42	+5		—40	+15		—276			+27	—20		—15	—62			
Other Oils[3]	—737	—690		+411	+330		+679	+420		—594	—355		66	—60		—71	
DEMAND																	
Total Demand	**10,801**	**10,825**	**0.2**	**9,302**	**9,435**	**1.4**	**9,139**	**9,415**	**3.0**	**10,317**	**10,550**	**2.3**	**9,662**	**9,889**	**2.3**	**10,054**	**1.7**
Gasoline	3,778	3,835	1.5	4,421	4,505	1.9	4,415	4,530	2.6	4,110	4,200	2.2	4,112	4,182	1.7	4,270	2.1
Kerosine	493	512	3.9	228	267	17.1	278	312	12.2	463	499	7.8	304	365	20.1	398	9.0
Distillate	2,738	2,760	0.8	1,414	1,440	1.8	1,238	1,290	4.2	2,239	2,260	0.9	1,843	1,907	3.5	1,934	1.4
Residual	2,014	1,905	— 5.4	1,435	1,375	— 4.2	1,245	1,275	2.4	1,630	1,655	1.5	1,602	1,580	— 1.4	1,551	— 1.8
All Other	1,778	1,813	2.0	1,804	1,848	2.4	1,963	2,008	2.3	1,875	1,936	3.3	1,801	1,855	3.0	1,901	2.5
Exports	**202**	**190**	**— 5.9**	**230**	**200**	**—13.0**	**193**	**200**	**3.6**	**192**	**190**	**—1.0**	**240**	**204**	**—15.0**	**195**	**— 4.4**
Crude Oil	9	6	—33.3	9	5	—44.4	6	5	—16.7	5	5		7	7		5	—28.6
Products	193	184	— 4.7	221	195	—11.8	187	195	4.3	187	185	—1.1	233	197	—15.4	190	— 3.6
Domestic Demand	**10,599**	**10,635**	**0.3**	**9,072**	**9,235**	**1.8**	**8,946**	**9,215**	**3.0**	**10,125**	**10,360**	**2.3**	**9,422**	**9,685**	**2.8**	**9,859**	**1.8**
Gasoline	3,744	3,800	1.5	4,373	4,460	2.0	4,378	4,490	2.6	4,070	4,165	2.3	4,055	4,142	2.1	4,231	2.1
Kerosine	490	510	4.1	226	265	17.3	276	310	12.3	460	495	7.6	301	363	20.6	395	8.8
Distillate	2,708	2,730	0.8	1,380	1,410	2.2	1,214	1,260	3.8	2,209	2,230	1.0	1,807	1,877	3.9	1,904	1.4
Residual	1,957	1,860	— 5.0	1,378	1,325	— 3.8	1,200	1,225	2.1	1,580	1,600	1.3	1,531	1,528	— 0.2	1,501	— 1.8
All other	1,700	1,735	2.1	1,715	1,775	3.5	1,878	1,930	2.8	1,806	1,870	3.5	1,728	1,775	2.7	1,828	3.0
Crude Runs to Stills	8,088	8,224	1.7	8,016	8,050	0.4	8,220	8,186	— 0.4	7,992	8,357	4.6	7,994	8,079	1.1	8,204	1.5

[1] Includes Alaska and Hawaii. [2] Partial estimate. [3] Refined products and natural gas liquids.

The 1960 output included an increase of 52,000 bpd or 5.9 percent over 1959. Natural gas liquids have been consistently gaining an increasing proportion of the market for oils. In 1961, nearing the 1 million bpd level, they will fill 11.8 percent of the demand for domestic oils.

Demand. Total demand for all oils in 1961 will average 10,054,000 barrels daily, up 165,000 bpd or 1.7 percent, according to the forecast. Exports will be off further by 9,000 bpd or 4.4 percent, to 195,000 bpd, almost all being products. Domestic demand will be up 174,000 bpd or 1.8 percent to 9,859,000 bpd.

The improvement of demand will occur principally in the latter half of the year. Total demand for the first half of 1961 is expected to increase only about 0.7 percent over the same period of 1960. But the gain in the latter half of the year is expected to be about 2.6 percent.

In the first quarter an increase of only 0.2 percent is predicted. But there will be gains of 1.4 percent in the second quarter, 3.0 percent in the third quarter, and 2.3 percent in the fourth quarter, to provide the annual increase of 1.7 percent.

The expected 1.7 percent gain for 1961 will be somewhat less than that of 2.3 percent in 1960 over 1959. But it will be almost equal to the average annual gain for five years. Up to and including 1956, petroleum demand was increasing in the early 1950s by an average of somewhat over 4 percent per year.

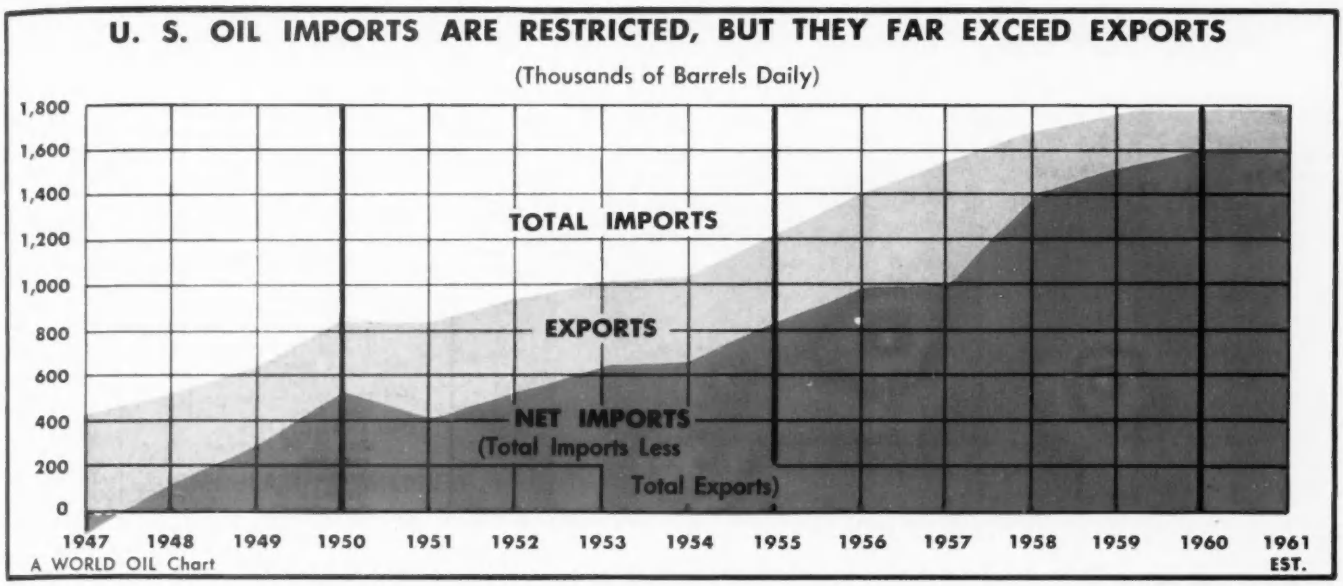
But since then the gains have averaged only about 1.8 percent per year. The estimate for 1961 is only 9.2 percent over demand in 1956. The demand increased 1.9 percent in 1957, decreased 0.3 percent in 1958, rose 3.2 percent in 1959 and 2.3 percent in 1960, and is expected to rise 1.7 percent in 1961.

Expected increases in 1961, compared with gains in 1960, include 2.1 percent versus 1.7 for gasoline, 9.0 percent against 20.1 for kerosine, and 1.4 percent versus 3.5 for distillate. Residual demand will further decrease 1.8 percent after dropping 1.4 percent the previous year. Kerosine is being used increasingly by commercial jet planes. Residual demand is being reduced by new natural gas pipe lines to the West Coast and import restrictions.

Demand for All Oils and Principal Products, by Years

Total, domestic, and export demand supplied by U. S. petroleum industry.
(Source: U. S. Bureau of Mines . . . Thousands of Barrels Daily.)

	ALL OILS			GASOLINE			DISTILLATE			RESIDUAL		
Year	Domestic	Exports	Total	Domestic	Exports	Total	Domestic	Exports	Total	Domestic	Exports	Total
1946	4,912	419	5,331	2,015	124	2,139	665	81	746	1,315	25	1,340
1947	5,451	451	5,902	2,178	130	2,308	817	82	899	1,421	29	1,450
1948	5,775	368	6,143	2,380	102	2,482	930	58	989	1,368	35	1,403
1949	5,803	327	6,130	2,503	108	2,611	902	34	936	1,359	35	1,394
1950	6,507	305	6,812	2,724	68	2,792	1,082	35	1,117	1,517	44	1,562
1951	7,053	422	7,475	2,992	110	3,102	1,230	62	1,292	1,546	79	1,625
1952	7,280	432	7,712	3,162	99	3,261	1,310	92	1,405	1,517	76	1,593
1953	7,604	401	8,005	3,303	104	3,407	1,337	89	1,426	1,536	71	1,607
1954	7,760	355	8,115	3,371	94	3,466	1,442	66	1,508	1,431	73	1,504
1955	8,459	368	8,827	3,655	95	3,750	1,592	67	1,659	1,526	93	1,619
1956	8,779	430	9,209	3,752	97	3,849	1,682	95	1,777	1,538	76	1,614
1957	8,818	568	9,386	3,816	106	3,922	1,688	131	1,819	1,504	106	1,609
1958	9,083	276	9,358	3,934	75	4,009	1,790	52	1,842	1,455	71	1,526
1959	9,491	219	9,710	4,083	47	4,130	1,834	39	1,873	1,551	61	1,612
1959	9,422	240	9,662	4,055	57	4,112	1,807	36	1,843	1,531	71	1,602
1960	9,685	204	9,889	4,142	40	4,182	1,877	30	1,907	1,528	52	1,580
1961 Est.	9,859	195	10,054	4,231	39	4,270	1,904	30	1,934	1,501	50	1,551



Controls expected to stop rise of imports

FOR U.S. OIL PRODUCERS, import controls are bringing some softening of the competition of foreign oils for markets within the United States. The controls of the past few years have arrested the previously sharp rise of imports and made the problem less alarming than formerly.

U.S. petroleum imports in 1961 will average 1,806,000 barrels daily, a slight decrease of 10,000 bpd from 1960, the Bureau of Mines has estimated. The imports of 1960 were up 36,000 bpd over 1959 and were the highest on record.

A slight decline in 1961 is predicted in spite of an expected increase in demand for petroleum. The required new supply of all oils in 1961 is forecast at 9,983,000 barrels daily. Domestic production is expected to furnish 81.9 percent of the total new supply in 1961, compared with 81.4 percent in 1960. Imports will furnish only 18.1 percent of supply in 1961, against 18.6 percent in 1960.

Controls slow increase. Imports were increasing sharply, by almost 200,000 bpd each year, in 1955 and 1956, and rose by 138,000 bpd in 1957 in spite of the slowing of shipments through the Suez Canal. Clamor against imports increased, and voluntary controls held the rise in receipts to 126,000 bpd in 1958. But stricter controls were demanded, and mandatory controls started in the spring of 1959 and have remained in effect. The imports consequently increased only 80,000 bpd in 1959 and 36,000 bpd in 1960. They are expected to decrease by 10,000 bpd in 1961.

While U.S. imports have been rapidly increasing since the end of World War II, U.S. oil exports have gradually declined from around 400,000 bpd to about 200,000 currently. In 1947 the country was still a net exporter of oil, with exports slightly exceeding imports. Since then it has been increasingly a net importer, until in 1960 the imports exceeded exports by a record 1,612,000 bpd. In 1961 nearly the same net imports (1,611,000 bpd) are forecast, with imports down a little but exports off a similar amount.

U.S. oil exports are forecast at only 195,000 bpd in 1961, a further decrease of 5,000 bpd. Crude oil exports have virtually ceased, being estimated at only 5,000 bpd in 1961. The expected 190,000 bpd of product exports will include: gasoline 39,000, kerosine 3,000, distillate 30,000, residual 50,000, and other petroleum products 68,000 bpd.

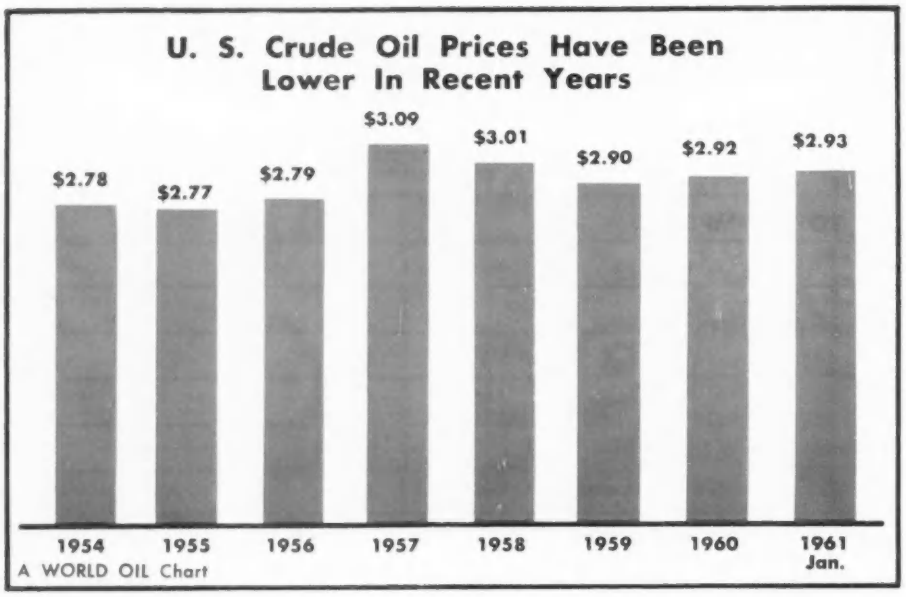
Excess of U.S. Oil Imports Over Exports, by Years

(Source: Bureau of Mines)

(Thousands of Barrels Per Day)

Year	IMPORTS			EXPORTS			NET IMPORTS		
	Crude Oil	Products	Total	Crude Oil	Products	Total	Crude Oil	Products	Total
1946..	236	141	**377**	116	303	**419**	120	162*	**42***
1947..	267	169	**437**	127	325	**451**	140	155*	**14***
1948..	353	161	**514**	108	259	**367**	245	98*	**147**
1949..	421	224	**645**	91	236	**327**	330	12*	**318**
1950..	487	363	**850**	95	210	**305**	392	153	**545**
1951..	491	354	**844**	78	344	**422**	413	10	**422**
1952..	573	379	**952**	73	359	**432**	500	20	**520**
1953..	648	386	**1,034**	55	347	**402**	593	39	**632**
1954..	656	396	**1,052**	37	319	**356**	619	77	**696**
1955..	782	466	**1,248**	32	336	**368**	750	130	**880**
1956..	934	502	**1,436**	78	352	**430**	856	150	**1,006**
1957..	1,023	552	**1,574**	138	430	**568**	885	122	**1,006**
1958..	953	747	**1,700**	12	264	**276**	941	483	**1,424**
1959..	965	814	**1,780**	7	233	**240**	958	581	**1,540**
1960..	1,028	788	**1,816**	7	197	**204**	1,021	591	**1,612**
1961†.	1,023	783	**1,806**	5	190	**195**	1,018	593	**1,611**

* Net Exports. † Estimate.



Crude oil prices gradually improving from low of 1959

FOLLOWING a protracted decline, U.S. crude oil prices have stabilized and made a limited recovery. From a peak of $3.09 per barrel in 1957, the average price at the well dropped to $3.01 in 1958 and to a low of $2.90 in 1959. That was a two year decline of 19 cents a barrel or 6.1 percent.

In 1960 there were no major changes, but limited increases were posted for certain grades and areas, and the average price rose 2 cents a barrel to $2.92. Currently, the average price is around $2.93 per barrel.

The prices are now generally firm. They appear quite safe at present levels. In fact, producers are beginning to hope for some improvement. This hope is based primarily on the fact that prices of petroleum products improved in the latter half of 1960 and promise to be firm in 1961. The improvement of product prices has resulted from reduction of surpluses of products and strict limitation of crude production, imports, and refinery runs.

Moderate increases in crude prices would be necessary to restore the postings of 1957. Such increases are needed, say producers, for while crude prices have declined, costs have increased. At the beginning of 1961 costs have increased further, through raising of wages and salaries.

Crude price reductions of 1958 and 1959 discouraged both development drilling and wildcatting. Conversely, increases may be necessary to stimulate drilling and an adequate rate of developing new reserves for future requirements. Such reserves generally are considered essential for the national security.

Limitation of petroleum imports has been an important factor in arresting the decline in U.S. crude prices and stabilizing postings. Voluntary controls helped to curb imports in 1958. And since early 1959, imports have been even more strictly limited by mandatory, governmental controls. Domestic crude prices meanwhile have stabilized, despite surpluses and sagging prices in world markets.

U.S. Average Prices of Crude Oil at Wells
Source: Bureau of Mines except 1961 est.

YEAR	($ Per Bbl.)	YEAR	($ Per Bbl.)	YEAR	($ Per Bbl.)
1918	1.98	1933	.67	1946	1.41
1919	2.01	1934	1.00	1947	1.93
1920	3.07	1935	.97	1948	2.60
				1949	2.54
1921	1.73	1936	1.09	1950	2.51
1922	1.61	1937	1.18		
1923	1.34	1938	1.13	1951	2.53
1924	1.43	1939	1.02	1952	2.53
1925	1.68	1940	1.02	1953	2.68
				1954	2.78
1926	1.88	1941	1.14	1955	2.77
1927	1.30	1942	1.19		
1928	1.17	1943	1.20	1956	2.79
1929	1.27	1944	1.21	1957	3.09
1930	1.19	1945	1.22	1958	3.01
				1959	2.90
1931	.65	1946	1.41	1960	2.92
1932	.87	1947	1.93	1961Jan	2.93

Crude Price Changes in Mid-Continent, California, and West Texas, by Years
(Dollars Per Barrel)

DATE	Okla., Kans. 36-36.9° Gravity	Calif., Long Beach 27-27.9°	West Texas Sour 30-30.9°
1937: Prior to Jan. 1	$1.10	$1.10	$0.78
January 28	1.22	....	0.88
1938: October 12	1.02	....	0.75
1939: No Changes	....	....	....
1940: February 1	....	1.03	....
1941: March 29	....	....	0.82
April 1	1.07	....	....
April 24	....	1.09	....
May 20	1.17	....	....
May 21	....	....	0.92
May 23	....	1.15	....
1942: Feb. 3; frozen at Oct. 1, 1941 level	1.17	1.15	0.92
1943 1944; 1945: No Changes; prices frozen	....	....	....
1946: April 1: OPA Raise	1.27	1.25	1.02
July 25: Oil Prices decontrolled	1.52	....	1.27
August 1	....	1.50	....
November 15	1.62	....	....
November 19	....	....	1.37
1947: March 10	1.87	....	1.62
March 19	....	1.75	....
July 1	....	1.95	....
October 15	2.07	....	....
October 16	....	....	1.82
December 6	2.57	....	2.32
December 27	....	2.45	....
1948: No Change	....	....	....
1949: June 1	....	2.37	....
1950: December 12	....	2.41	....
1951: Frozen at Jan. 25 level	2.57	2.41	2.32
1952: No Changes; frozen	....	....	....
1953: Feb. 16: decontrolled	....	2.76	....
June 15	2.82	....	2.57
1954: No Change	....	....	....
1955: No Change	....	....	....
1956: November 21	....	2.92	....
1957: January 3	3.07	....	2.82
January 17	....	3.17	....
1958: June 24	....	3.06	....
October 3	2.93 / 3.00	....	....
1959: January 26	....	2.95	....
February 4	....	....	2.65
February 20	2.97	....	....
September 11	....	2.74	....
1960: No Changes	....	....	....

Changes in Prices of Bradford, Pennsylvania, Crude, by Years
(Dollars Per Barrel)

Date	Price	Date	Price	Date	Price
1937:		[2]1943:		1953:	
Before Jan. 1	$2.15	[3]1944:		Feb. 16	4.40
Feb. 24	2.67			Aug. 1	4.55
June 7	2.82	[3]1945:		Sept. 21	4.05
Sept. 1	2.60				
Oct. 12	2.35	1946:		1954:	
Dec. 1	2.20	[4]April 1	3.10	Jan. 1	3.76
		[5]Aug. 1	3.35	May 20	3.26
1938:		Sept. 1	3.41	Sept. 1	3.23
Mar. 7	2.05	Dec. 9	3.55	Dec. 1	3.35
June 13	1.80				
Sept. 1	1.68	1947:		1955:	
		Jan. 1	3.65	Jan. 21	3.50
1939:		Mar. 1	3.81	July 11	3.60
Jan. 21	1.80	April 1	3.91	Nov. 1	3.75
Feb. 1	1.88	May 16	4.05	Dec. 1	3.85
Mar. 6	2.00	July 1	4.30		
Oct. 6	2.25	Sept. 1	4.50	1956:	
Nov. 1	2.40	Dec. 1	5.00	Feb. 6	4.00
Dec. 1	2.50			Mar. 16	4.20
		1948:		May 16	4.45
1940:		Dec. 11	4.50	July 16	4.57
Jan 1	2.75			Aug. 16	4.68
May 22	2.50	1949:			
June 18	2.25	Jan. 21	4.00	1957:	
July 12	2.00	Mar. 11	3.75	Jan. 16	4.88
Aug. 18	1.85	April 1	3.55	July 26	4.65
Nov. 12	2.00	April 13	3.40		
Dec. 17	2.15	May 11	3.27	1958:	
		June 16	3.40	Feb. 3	4.40
1941:		Dec. 12	3.54	Apr. 16	4.15
Jan. 27	2.30			June 18	3.90
April 23	2.40	1950:		Dec. 22	4.05
May 20	2.55	May 1	3.65		
June 18	2.75	June 21	3.75	1959:	
Aug. 14	2.98	July 19	3.89	Apr. 1	4.15
Aug. 23	2.75	Aug. 25	4.00	May. 1	4.25
		Oct. 9	4.10	Sept. 12	4.40
1942:		Dec. 9	4.25		
[1]Feb. 3	2.75			1960:	
[2]Mar. 26	3.00	[6]1951:		Jan: 11	4.55
		[6]1952:		Apr. 26	4.70
				Aug 1	4.80

[1] Frozen at Oct. 1, 1941 level. [2] Penn. grade raise granted. [3] No change; price frozen. [4] Raise granted by OPA. [5] Oil prices decontrolled July 25, 1946. [6] No change; price frozen at Jan. 25, 1951, level.

What's new in the drilling industry

By **Jack F. Earl,** Engineering Editor, WORLD OIL

ALTHOUGH NO RADICAL changes occurred last year in drilling technology, several new types of equipment and improved practices emerged which are helping drilling contractors compete in an industry besieged by mounting costs.

Some of the more important improvements which resulted from extensive research, engineering, and practical field application of current drilling equipment and techniques include:

CIRCULATING MEDIUM

Aerated sea water. This technique was used off the Florida shore in Bahamas California Oil Company's Cay Sal Bank Well 1.[1] This well was drilled to a depth of 15,138 feet using this circulating medium.

Conditions favoring the use of aerated sea water are:

- Abundant supply of sea water.
- Formations to be drilled contain no shales or bentonitic sands. A well consolidated carbonate section is considered ideal.
- Extreme lost circulation conditions anticipated.
- No disposal problem of excess produced water.
- No uncased up-hole horizons containing mobile hydrocarbons.

Although this practice was successful in the above operation, limitations in using this method must be considered. They are:

1. Quality and quantity of ditch samples are reduced as compared with conventional mud systems.

2. Quality of electric logs is reduced.

3. Horizons having greater than normal formation pressures can not be drilled effectively with this method.

4. Hole size is significant in determining the amount of available air needed.

5. Regular bits should be used since jet bits usually require circulating pressures greater than normal air compressor design.

6. No apparent depths limitation provided compressor design capacity is sufficient to meet normal circulation pressures.

While drilling the 17½-inch surface hole to 4,000 feet, the proportion of sea water to air was one gallon of sea water to 2 to 4 standard cubic feet of air. Circulating pressures varied from 650 to 750 psi with a circulating rate of sea water varying from 900 to 400 gpm.

The 12¼-inch hole, which was drilled to 9,947 feet, used the same air-water ratio; however, the injection rate of water was decreased to 360 gpm and the air increased to 1,800 cfm. The returns for both sizes of holes varied from 150-200 percent greater than the input of sea water (Figure 1).

After reducing to an 8½-inch hole (9⅝-inch casing was set at 8,012 feet), a rate of 360-300 gpm was used with a ratio of 5-6 scfm of air to water. The maximum pressure attained was 900-1,000 psi.

Some problems resulting from the use of this circulating medium are listed here.

- Dilution caused by invading sea water from porous formation made it difficult to maintain a high pH factor in the injection water.
- Absence of a filter cake and lubricating qualities of mud.
- In highly porous sections, good formation samples were hard to obtain.
- High cost of maintaining air compressor installation.
- Annular return exceeded 100 percent while drilling.
- Corrosion control was expensive.
- Compressors were not rugged enough.
- Inadequate control of air input to maintain returns of 100 percent.
- Pipe corrosion prevention.

Air/gas drilling. Use of air-gas as the circulating fluid has not seen any radical improvements. Air or gas, when proper hole conditions prevail, still offers considerable savings in drilling penetration rate performances.

The water shut-off still remains the biggest problem for expanding the use of air or gas.

Foaming agents have enhanced the use of this type of circulating medium in several areas heretofore believed to be impracticable.

Considerable amount of work has been undertaken in this foaming agent field.[2] During the past three years, foaming agents have been used in 60-70 percent of air-drilled wells, either continuously or at various intervals, to remove excess water and cuttings from the hole. If present drilling trends continue, an estimated 14 million feet of hole will be drilled with air during 1963.

It has been found that the most critical property of a foaming agent is its resistance to contaminants, such as sodium chloride, oil, and clay cuttings.

A new foaming agent has been discovered which will foam under model well conditions in almost exactly the same manner as the commercial agents foam water.

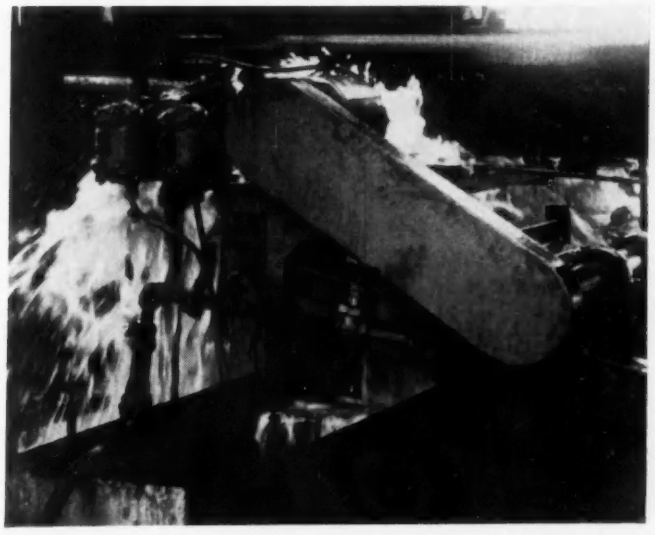
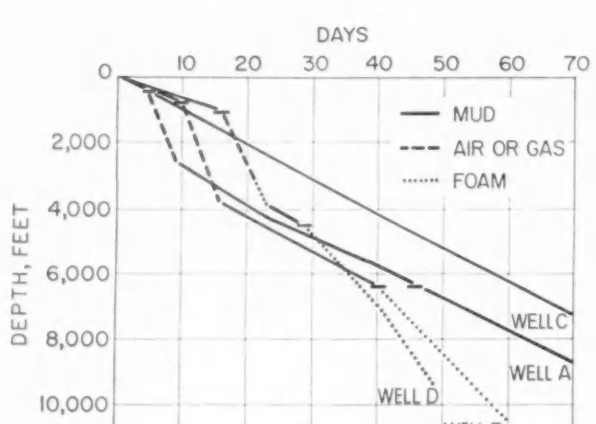
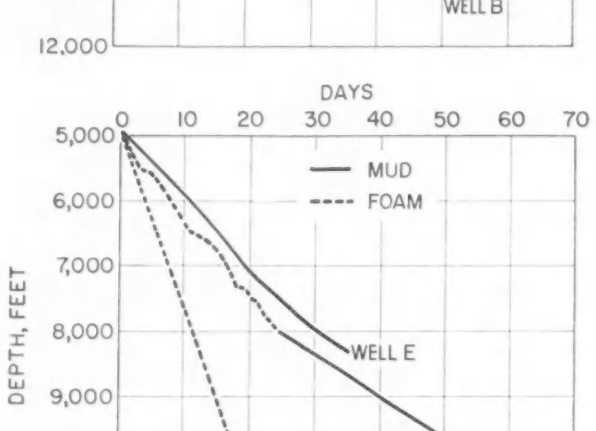


FIGURE 1—The influx of sea water into the well bore resulted in a 150-200 percent increase over the input of the circulating fluid.





FIGURES 2 and 3—Here are shown comparative drilling curves using air/gas, mud or foam as the circulating medium.

The use of the oil foaming agents dissolved in diesel oil or kerosine should permit gas drilling of producing formations and cleanout of producing wells with even less damage by blocking the formation pores and cleaning of the well than is now achieved with water foam.

Figures 2 and 3 show the comparative drilling performance of using the three types of drilling mediums: mud, air/gas or foam. The best drilling performance is achieved with air or gas; however, as can be observed from the chart, foam drilling attains approximately the same penetration rate slope and offers a considerable improvement over the use of mud.

Personnel, drilling and operating, are becoming more familiar with the use of air/gas which has led to a greater acceptance of the circulating medium. Several safety and educational programs have been conducted to acquaint the personnel with air/gas techniques.

More experience is being gained with the use of combating corrosion problems and presently this is not considered an alarming problem.

Equipment manufacturers have developed boosters and compressors to accommodate present volumetric and pressure requirements.

High mud densities. Extensive experience is being gained in the Agha Jari field in Iran using 18-22 ppg mud. This weight of mud was necessary to handle severe lost circulation, extreme high-pressure water flows and salt beds of a thousand feet or more.

Preparation and control of very high density saturated salt muds present serious problems. For example, if attempts are made to prepare the 22 ppg mud with unsuitable barites, the resultant mud will be "thick enough to walk on." Barites quality is of critical importance because it is overwhelmingly the major ingredient, comprising over 99 percent by weight of the undissolved solids. A minor impurity in barites which might cause no trouble in moderate density muds can cause disastrous difficulties in an extreme weight mud.

Clay is often an impurity in crude barites and unless the barites are processed by the manufacturer to remove substantially all of the clay, 2 percent or less, the barites will be unsuitable for heavy muds.

Clay-free salt water muds. This type of mud was first introduced in West Texas.[3] The mud solids of this type of mud are 2 percent compared to 6 to 12 percent of conventional muds of the same weight, while the water loss is held below 10 cc.

This mud has offered advantages over the older types of mud, including:

- Better hydraulics.
- Increased bit life.
- Minimized pump wear.
- Increased penetration rates.
- Lowered mud cost in 10 ppg density range.

The clay-free salt-water mud is composed of the following:

Saturated or unsaturated salt water, lb. per bal.	8.6-10
Gum lb. per bbl.	.5-1
Starch lb. per bbl.	1
Oil, Vol. %	0-25
Preservative, lb. per bbl.	0-25
Anticorrosion, lb. per bbl.	.5
Emulsifier, gal. per bbl. of oil	.25

This type of mud is being adopted when drilling shallow wells with the salt section being exposed. A reduction in solids content has been the general trend for operators in West Texas. This has been accomplished with two types of conventional types of mud—bentonite—chemically treated fresh-water mud and the salt-water clay-starch mud.

Although clay-free salt water mud has been fairly successful in shallow wells with the salt section exposed, it is not recommended for deep drilling because:

- Conventional log results are poor.
- Troublesome shale intervals will present problems.
- Increased corrosion problems will exist.
- Low thixotropic properties will be present.
- Unsatisfactory performance in washed out intervals result.

NEW RIG DESIGNS

Substructure height reduced. Delta Drilling Company has recently redesigned its standard rig into a highly mobile jackknife rig (Figure 4).

The drawworks and engines are located on a substructure only five feet off the ground. The entire rig substructure is composed of four parts and can be moved in three loads.

The derrick floor has no equipment except the driller's console, rotary table, cathead and make up/breakout equipment.

This rig offers the following advantages:

- Jackknife derrick used instead of standard derrick.

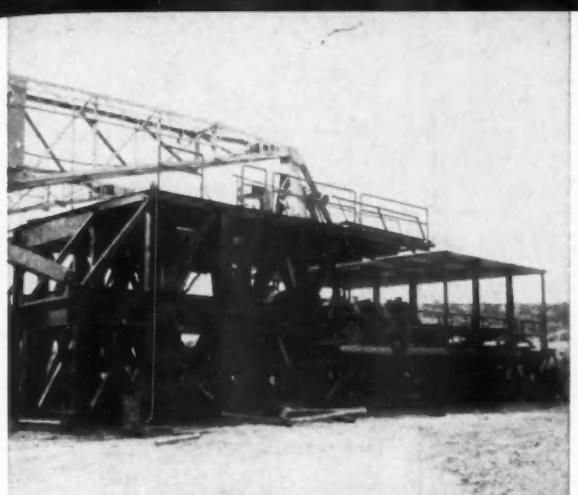


FIGURE 4—The substructure has been modified whereby the engines and drawworks are now located only 5-feet off the ground.

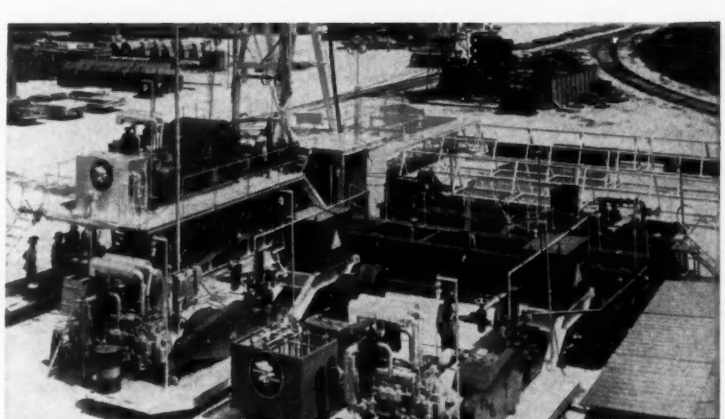


FIGURE 5—This mobile drilling rig is being used in Africa to combat rugged terrain moving operations.

- Engines and drawworks are on the same level and only five feet off the ground.
- Derrick floor offers greater safety working environment.
- Installation of engines and drawworks do not require a high-steep ramp.
- Rig up time is decreased.

This rig is designed to satisfy drilling depths of 12,000 feet, rated capacity of the derrick.

New portable drilling rig. Falcon Seaboard Drilling Company found drilling conditions in the Spanish Sahara dictated the redesigning of present mobile drilling rig equipment (Figure 5).[4]

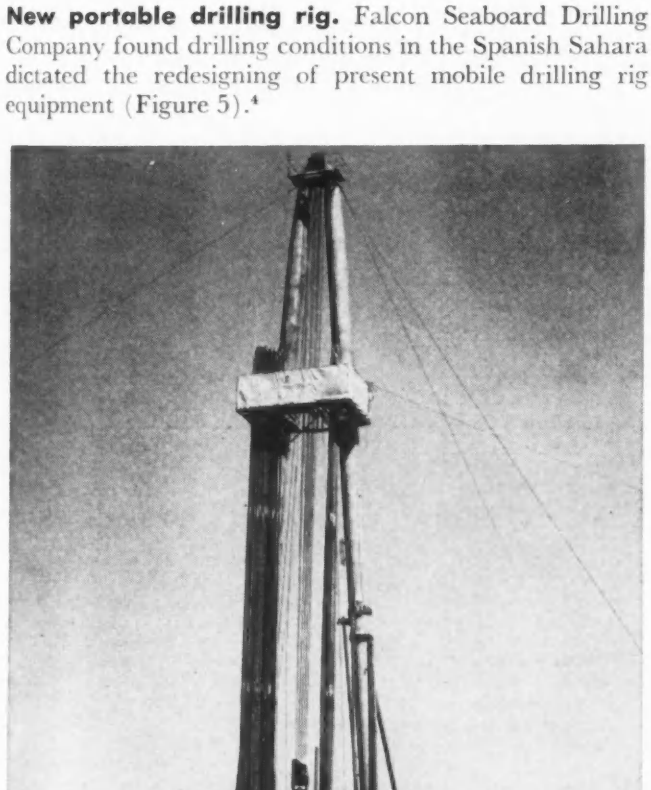


FIGURE 6—Overall view of new type German rig.

The rig was designed for maximum portability on rough terrain. Several new design features were made in the mast, slush pumps and compressor assembly.

The mast, while in its telescoped position and mounted on dual trailers can be easily transported over rough terrain. The mast is rated at 250,000 pounds with eight lines.

Each of the two pumps is mounted on a sinkable trailer with the trailer forming the skid base during drilling operations (Figure 5). This minimizes loading and unloading difficulties in moving operations. Each pump is driven by a twin 300 hp diesel engine. Additional rig equipment includes two 150-barrel mud tanks, a shale shaker, a desander and a chemical mixer.

New type rotary rig drive. A new type German rig is presently being operated successfully after several months of field testing (Figure 6).[5]

This rig offers several new design and layout features, including:

- All engines are equipped with disengaging torque converters.
- Mud pumps are equipped with swing-gears to protect the prime mover from pump shocks.
- Torque converters are equipped with temperature and overspeed governors.
- Jaw clutches are used instead of chain drives.

To serve the drawworks, a four-speed reduction-gear box with a reverse gear is directly connected to the torque converter in one housing. The gear selection in this unit is by means of over-running jaw clutches. Two main rig motors transmit power to the drawworks by torque shafts with universal joints and are compounded by a reduction gear inside the drawworks to drive either the hoisting drum or, by means of a separate drive, the rig mud pump. Either power package may be switched so that either the pump or drawworks may be operated independently.

The torque unit is used as a brake and no special hydromatic brake is necessary, thus reducing maintenance costs.

NEW TOOLS AND EQUIPMENT

Hydraulic wall-anchored drill collars. To obtain high bit weight near the surface and reduce tripping time at depth, a new light-weight, high output force applicator—

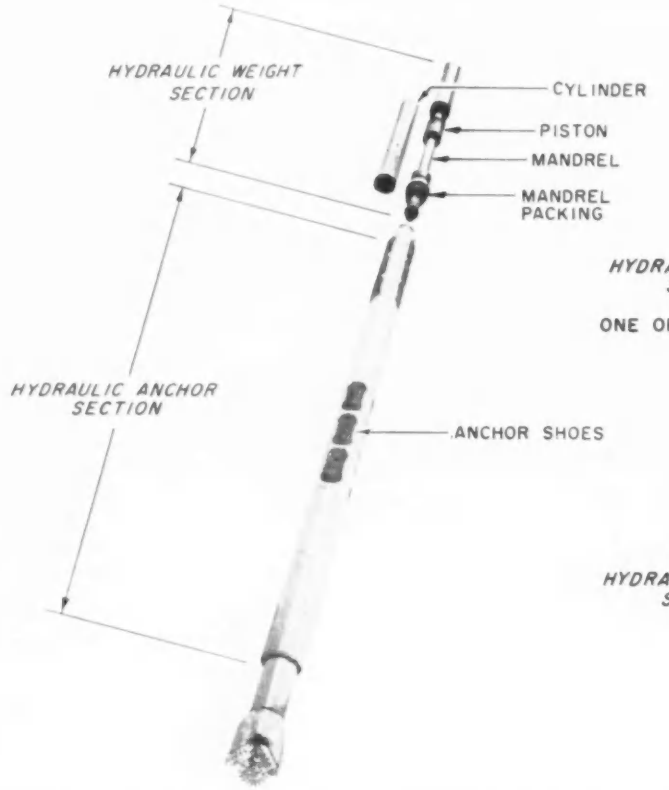


FIGURE 7a—Hydraulic wall-anchored drill collar broken into the hydraulic anchor section and the hydraulic weight section.

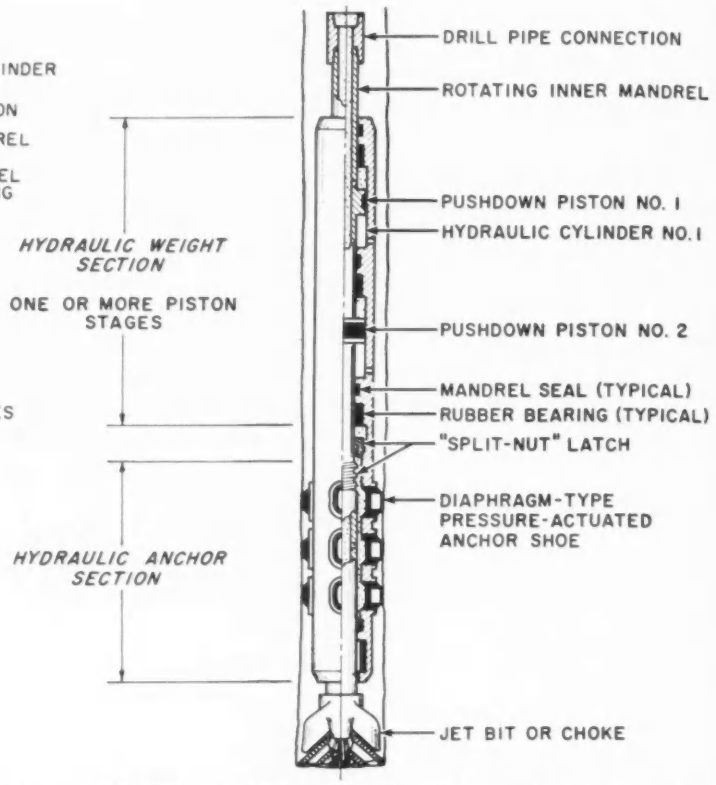


FIGURE 7b—This schematic diagram shows the hydraulic wall-anchored drill collar and its component parts.

the hydraulic wall-anchored drill collar—was developed. (Figure 7).[5]

The primary advantages of this tool are:

- Surface hole can be drilled more economically where the use of sufficient bit weight is prevented by limitation of drill collar lengths.
- Drill collar handling time is reduced.
- Hoisting power requirements are lower as rig depth rating is increased.
- Initial investment costs are lower.

This collar is the first tool to provide bit loading without the use or aid of dead weight.

New aluminum drill string. Aluminum drill pipe recently has been introduced with the drilling of a 10,400-hole by Shell Oil Company in South Texas (Figure 8).

Although this was the first well completely drilled using aluminum drill pipe, it is not a conclusive test for world-wide industry acceptance. Additional footage will be necessary before this may be considered.

Present plans are to obtain experience in varied drilling areas and drilling conditions.

The first test did show that:

- Shell's Rig 25, which heretofore was not able to drill

FIGURE 8—Here is shown the first complete string of aluminum drill pipe with steel tool joints.

Table 1

PHYSICAL PROPERTIES OF ALUMINUM, STEEL DRILL STRING

	Experimental Aluminum Drill Pipe 4½-in.	API Standard 4½-in., 16.60-lb. Grade E Drill pipe
Outside diameter, in	4.650	4½
Inside diameter, in.	3.615	3.826
Wall thickness, in.	0.517	0.337
Weight per foot with tool joints, lb.	11.20	17.90
Weight per 30-ft. joint, lb. in air	343	536
in 10-lb. mud	218	455
Ultimate length to yield strength, ft. with no collar load hanging in air	34,100	18,500
with no collar load hanging in 10-lb. mud	53,600	21,800
Torsional strength, in.-lb.	467,000	480,000
Collapse pressure, psi.	10,300	8,300
Internal yield pressure psi.	11,600	9,800
Minimum tensile yield, lb.	388,000	330,000
Fatigue endurance, million cycles on rotating cantilever at 150,000-in.-lb. moment	0.8 to 1.5	0.5 to 0.8

below 8,000 feet, drilled to a depth of 10,400 feet.

- No damage was observed in the aluminum pipe from slips, tongs or elevators.
- No apparent damage from corrosion or pitting. The pH of the mud never exceeded 9.
- Pump pressures were not as high as have been observed with 4½-inch steel pipe.

The question is: How much will it cost? This has not been derived at the present; however, the manufacturer says the final price will be low enough to create a demand.

The physical properties of the aluminum versus steel pipe are shown in Table 1.

New configuration drill collars. Drill collar wall sticking has been a continuous problem in drilling Gulf Coast wells.

To eliminate or minimize this problem, a new type special drill collar recently has been introduced (Figure 9).[7]

The surface area of these drill collars has been changed to reduce wall contact area by more than 40 percent; however, weight of the original collar has been reduced only by 4 percent.

Any new or used drill collar, regardless of size, may be converted to this new type of configuration. The collar is milled off giving a "spiral like" appearance to the collar.

Drift recording device. A new simple signaling instrument has been introduced to determine the angle of a bore hole from vertical as often as needed.[8]

FIGURE 9—Gulf Coast drilling wall sticking problems have been minimized using this new drill collar configuration pattern.

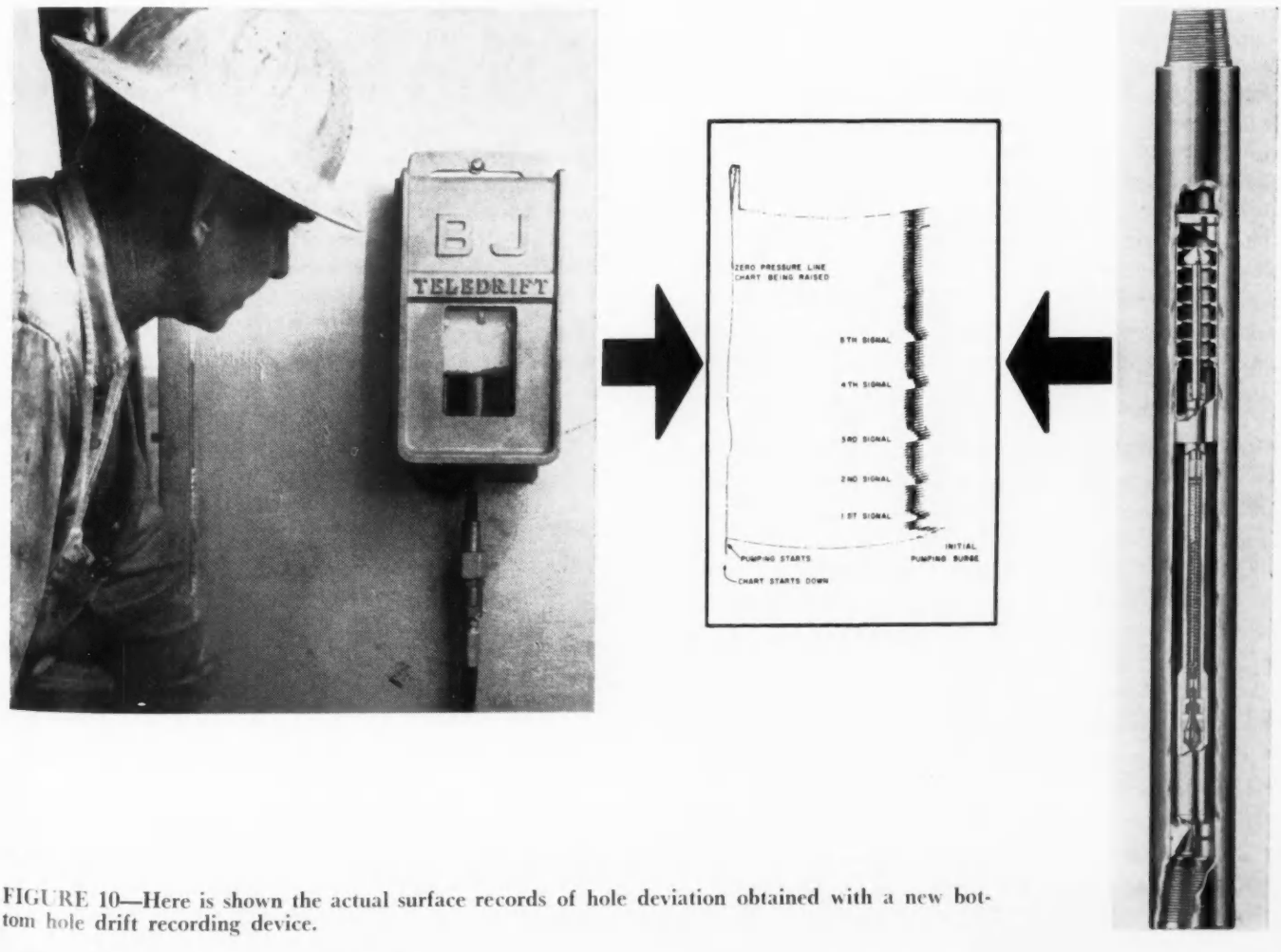


FIGURE 10—Here is shown the actual surface records of hole deviation obtained with a new bottom hole drift recording device.

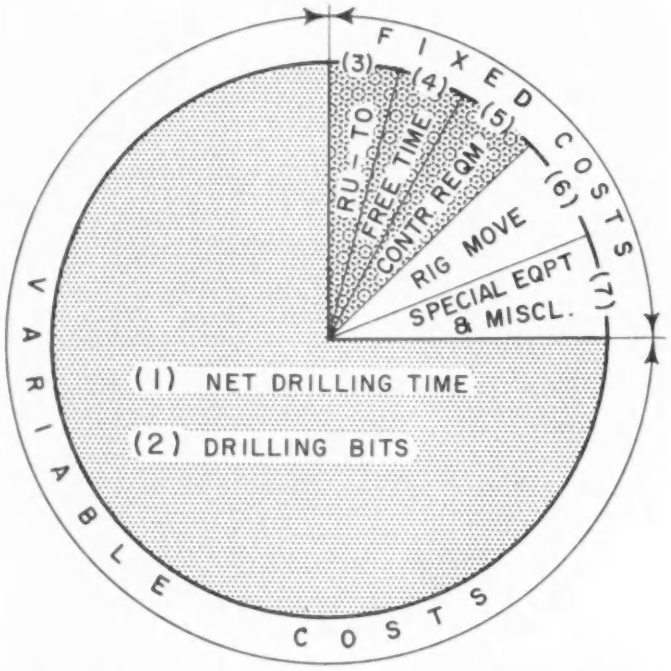


FIGURE 11—Accurate drilling bids can be rendered only after a true evaluation is obtained of the fixed and variable costs encountered in certain areas of operations.

The device normally is put in a 7-foot sub having the same OD as the drill collar, and is positioned immediately above the bit. Readings are obtained by lifting the bit off bottom, stopping rotation and—with the pipe still—shutting down mud pump for 45 to 60 seconds. Pumps are then started and a series of pulses, or pressure surges, arrive at the surface through the mud stream (Figure 10). The number of pulses indicates the degree of hole angle.

The pulses, each representing one-half degree of hole angle unless shop altered to satisfy any other field requirement within the 10½-degree maximum recordable angle attainable, are recorded on a 3-inch by 5-inch chart located near the driller's position.

A reading may be taken as often as desired. Usually, it is taken each time a single is added or at each round trip.

IMPROVED DRILLING PRACTICES

High weights and speed increase penetration rates. To maintain a competitive position within the drilling industry today, the contractor is having to explore all areas to improve its drilling practices.

Gulf Oil Corporation now is using drilling practices on the Gulf Coast that were believed impractical a few years ago.[9] These practices include:

- Maximum efficient hydraulic program (400 feet per second jet velocities)
- Exceptionally high bit weights (80,000 to 100,000 lbs.)
- Fast rotary speeds (150-300 rpm)
- Decreasing WOC
- Eliminating slope tests while drilling
- Eliminating reaming to bottom before new connection
- Keeping sand content of drilling mud very low (2 percent and less).

The total time to drill from spud to a depth of 10,000 feet was 4 days and 22 hours.

Cooperation and teamwork of the rig personnel contributed immensely to the over-all time performance.

The rig was equipped with two 1,000-hp pumps, an independent electric rotary drive and a diesel electric-driven drawworks.

The maximum pump pressure after drilling out under the surface string was 2,200 psi.

Forecasting accurate drilling costs. Drilling contractors are finding it imperative to determine with the greatest accuracy possible factors on which drilling bids will be based.

Figure 11 indicates the relative amounts of "variable" and "fixed" costs incorporated in footage prices.[10]

The profile method of estimating drilling penetration rates and drilling bit requirements has shown that net drilling days and bits can be forecast consistently with an accuracy of 95-97 percent where normal drilling conditions are involved.

New studies on bit weights and speed. Recent work by a bit manufacturer and the American Association of Oilwell Drilling Contractors has proven that to establish the most economical weight and rotary speed to run on a rock bit, it is necessary to know:

- The relation between drilling rate and the factors that affect it.
- The relation between the rate of drilling of the cutting structure of the bit and the factors that affect it.
- The relation between bearing wear rate and the factors that affect it.

After thorough testing in the laboratory and in the field the following conclusions were reached relative to how a tooth bit or tungsten carbide type of bit should be run:

- **Tooth bit**
  1. Weight should be increased as bit drills.
  2. Rotary speed should be increased as the bit drills.
  3. The proper variation of weight and rotary speed is dependent on formation abrasiveness, drilling fluid, trip time, rig cost per hour and bit cost.
- **Tungsten carbide bits**
  1. Weight and rotary speed should remain constant during bit run.
  2. The proper constant weight and rotary speed is dependent on drilling fluid, trip time, rig cost per hour and bit cost.

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[10] Mecham, O. E., Legge, M. E., "How to Forecast Accurate Drilling Costs," World Oil 150, No. 12, 112-116 (1960).
[11] Galle, E. M., Woods, H. B., "Variable Weight and Rotary Speed for Lowest Drilling Cost," American Association of Oilwell Drilling Contractors, New Orleans, 1960.

Forecast of New Wells and Footage to Be Drilled in 1961

Includes new wells drilled for oil or gas, salt-water disposal wells, water input wells, and gas-input wells. Does not include old wells drilled deeper

STATE or DISTRICT	Total New Wells			Footage (New Wells)		
	1961 Forecast	1960 Actual	% Dif.	1961 Forecast	1960 Actual	% Dif.
Alabama	60	52	+ 15.4	480,000	470,425	+ 2.0
Alaska	50	24	+108.3	455,000	240,969	+88.8
Arizona	30	26	+ 15.4	81,000	67,467	+20.1
Arkansas	635	591	+ 7.4	2,254,250	2,129,789	+ 5.8
California	1,700	1,691	+ 0.5	6,630,000	7,145,783	— 7.2
Colorado	730	694	+ 5.2	3,650,000	3,548,526	+ 2.9
Illinois	1,900	1,922	— 1.2	4,180,000	4,099,494	+ 2.0
Indiana	1,050	1,040	+ 1.0	1,470,000	1,405,822	+ 4.6
Kansas	4,780	5,039	— 5.1	16,969,000	17,725,692	— 4.3
Kentucky	2,800	2,931	— 4.5	2,100,000	2,309,276	— 9.1
Louisiana	3,515	3,638	— 3.4	26,486,250	27,972,877	— 5.3
N. Louisiana	1,455	1,450	+ 0.3	5,165,250	5,331,593	— 3.1
S. Louisiana	2,060	2,188	— 5.9	21,321,000	22,641,284	— 5.8
*Gulf of Mex.	500	505	— 1.0	5,150,000	5,173,068	— 0.5
Michigan	800	852	— 6.1	2,920,000	3,109,570	— 6.1
Mississippi	750	708	+ 5.9	7,275,000	6,944,981	+ 4.8
Missouri	11	13	— 15.4	21,450	31,861	—32.7
Montana	320	324	— 1.2	1,520,000	1,570,996	— 3.3
Nebraska	970	926	+ 4.8	5,141,000	5,101,070	+ 0.8
New Mexico	1,778	1,817	— 2.2	9,036,400	8,997,968	+ 0.4
So. E. N.M.	1,150	1,199	— 4.1	5,865,000	6,082,654	— 3.6
No. W. N.M.	628	618	+ 1.6	3,171,400	2,915,314	+ 8.8
New York	390	336	+ 16.1	565,500	524,822	+ 7.8
North Dakota	183	273	— 33.0	1,162,050	1,715,525	—32.3
Ohio	950	1,045	— 9.1	2,327,500	2,557,693	— 9.0
Oklahoma	4,775	4,537	— 5.2	16,712,500	16,971,324	— 1.5
Pennsylvania	934	838	+ 11.5	2,615,200	2,352,980	+11.1
South Dakota	16	18	— 11.1	96,000	127,687	—24.8
Tennessee	97	93	+ 4.3	87,300	78,767	+10.8
Texas	14,352	15,050	— 4.6	67,510,050	68,206,484	— 1.0
Dist. 1: S. C.	900	1,117	— 19.4	2,115,000	2,891,315	—26.9
Dist. 2: M. G.	703	738	— 4.8	4,850,700	5,007,267	— 3.1
Dist. 3: U. G.	1,015	1,116	— 9.1	9,997,750	9,454,385	+ 5.7
Dist. 4: L. Gulf-S.W.	1,150	1,055	+ 9.0	6,382,500	5,887,046	+ 8.4
Dist. 5: E. C.	171	211	— 19.0	846,450	1,039,729	—18.6
Dist. 6: N.E.	888	879	+ 1.0	4,706,400	4,716,538	— 0.2
Dist. 7-B: N.C.	2,153	2,179	— 1.2	6,459,000	6,520,638	— 1.0
Dist. 7-C: W. C	725	777	— 6.7	2,972,500	3,206,031	— 7.3
Dist. 8: West	2,922	2,994	— 2.4	17,532,000	16,982,771	+ 3.2
Dist. 9: North	2,680	2,871	— 6.7	7,102,000	7,528,032	— 5.7
Dist. 10: P.H.	1,045	1,113	— 6.1	4,545,750	4,972,732	— 8.6
Utah	205	210	— 2.4	1,199,250	1,191,454	+ 0.7
West Virginia	1,213	1,016	+ 19.4	2,971,850	2,581,364	+15.1
Wyoming	1,051	1,038	+ 1.3	5,255,000	5,238,364	+ 0.3
†Other States	34	36	— 5.6	154,700	164,112	— 5.7
Total U.S.	46,079	46,778	— 1.5	191,326,250	194,583,142	— 1.7

*Included in South Louisiana. †Includes Florida, Georgia, Idaho, Maryland, Nevada, North Carolina, Oregon, Virginia, and Washington.

Drop in U.S. drilling in 1961 forecast

WORLD OIL's annual drilling survey, based on detailed analyses of oil company drilling programs, forecasts the drilling of 46,079 new wells and 191.3 million feet of hole in the United States during the current year.

This would reflect a slight downturn of 699 wells, or 1.5 percent, from the 46,778 wells completed in 1960, and 3.2 million feet of hole, or 1.7 percent less than the 194.5 million feet drilled in 1960.

However, a gradual improvement in domestic demand and limited recovery and stabilization of crude prices is foreseen for the year.

An increase in production of crude oil and natural gas liquids is expected to reach almost 3 percent. A major advantage in this for producers is anticipated to arise from a slight decrease in imports and the inability to draw materially—as in 1960—on crude stocks, which now are near minimum working requirements.

And paralleling this is the fact that, after a protracted decline, U.S. crude oil prices have stabilized and made a limited recovery. Indeed, producers are beginning to even hope for some improvement. This situation may be contrasted with the crude price reductions of 1958 and 1959 which, of course, discouraged both development drilling and wildcatting.

Wells Completed Annually in United States

Source: WORLD OIL and predecessor, The Oil Weekly, with aid of other authoritative sources, 1921 to now; 1920 and earlier years from U.S. Bureau of Mines and "Petroleum in the United States and Possessions," by Arnold and Kemnitzer.

YEAR	Oil and Gas Tests				Service Wells			Total New Wells			Old Wells Drilled Deeper	Total Completions
	Oil	Distillate	Gas	Dry	Water Input	Gas Injection	Salt Water Disposal	New Wells Drilled	*Footage Drilled	*Avge. Well Depth		
1859-†												
1940	750,064	.....	70,797	229,858	23,909	.....	.....	1,074,628	.....	....	.....	1,074,628
1941	19,590	.....	3,279	7,280	2,197	117	47	32,510	99,347,714	3056	822	33,332
1942	10,977	105	2,685	5,962	2,141	73	47	21,990	76,903,053	3088	588	22,578
1943	9,887	76	2,314	6,364	1,576	90	42	20,349	61,991,857	3046	471	20,820
1944	13,502	54	3,024	7,153	1,784	218	51	25,786	84,378,457	3272	377	26,163
1945	13,944	153	3,039	7,346	1,796	329	42	26,649	92,982,113	3489	491	27,140
1946	16,087	207	3,355	8,496	1,816	219	50	30,230	101,124,813	3345	615	30,845
1947	17,613	283	3,437	9,751	1,861	156	46	33,147	112,816,124	3404	651	33,798
1948	22,197	346	2,966	11,939	1,885	84	60	39,477	136,709,153	3463	533	40,010
1949	21,415	378	3,121	12,898	1,036	56	58	38,962	138,616,941	3558	535	39,497
1950	23,775	465	3,015	14,918	993	38	103	43,307	159,761,732	3689	751	44,058
1951	23,532	344	3,198	17,497	1,323	35	67	45,996	176,757,221	3843	770	46,766
1952	23,371	348	3,345	18,211	1,147	25	62	46,509	188,392,695	4051	537	47,046
1953	25,251	374	3,858	18,759	1,123	25	90	49,480	198,431,603	4010	486	49,966
1954	28,063	672	3,547	19,137	682	21	75	52,197	211,296,158	4048	498	52,695
1955	30,474	709	3,460	20,564	551	13	108	55,879	228,529,688	4090	535	56,414
1956	30,641	551	3,944	22,254	852	10	166	58,418	235,386,441	4029	476	58,894
1957	27,519	743	3,879	20,250	1,281	7	104	53,783	220,863,576	4107	390	54,173
1958	24,311	710	4,319	18,421	1,184	5	151	49,101	196,507,188	4002	439	49,540
1959	25,532	800	4,070	18,669	912	12	184	50,179	206,199,165	4109	481	50,660
1960‡	22,233	750	4,379	18,185	1,021	21	189	46,778	194,583,142	4160	397	47,175
Total	1,179,978	8,068	139,031	513,912	51,070	1,554	1,742	1,895,355	.....	....	10,843	1,906,198

*Footage data not available prior to 1925 and estimated 1925-1930; actual statistics after 1930. † For annual data, 1918-1940, see WORLD OIL, Feb. 15, 1959, page 93. ‡ Data for 1960 subject to slight revision.

Footage and Average Depths Drilled in All Wells in the United States in 1960

STATE or DISTRICT	TOTAL NEW WELLS (See Below)						OIL WELLS DRILLED DEEPER, 1960 (Productive and Dry)			TOTAL ALL WELLS					
	1960			1959						1960			1959		
	Wells	Footage	Avge. Depth	Wells	Footage	Avge. Depth	Wells	Footage	Avge. Depth	Wells	Footage	Avge. Depth	Wells	Footage	Avge. Depth
Alabama	52	470,425	9,047	108	976,926	9,046				52	470,425	9,047	108	976,926	9,046
Alaska	24	240,969	10,040	14	141,670	10,119				24	240,969	10,040	14	141,670	10,119
Arizona	26	67,467	2,595	36	94,329	2,620				26	67,467	67,467	36	94,329	2,620
Arkansas	591	2,129,789	3,604	814	2,728,131	3,352	4	4,056	1,014	595	2,133,845	3,586	817	2,730,047	3,342
California	1,691	7,145,783	4,226	1,520	7,240,301	4,763	101	116,841	1,157	1,792	7,262,624	4,053	1,660	7,422,519	4,471
Colorado	694	3,548,526	5,113	726	3,818,603	5,260	6	11,333	1,889	700	3,559,859	5,086	729	3,821,368	5,242
Illinois	1,922	4,099,494	2,133	2,033	4,492,151	2,210				1,922	4,099,494	2,133	2,034	4,493,084	2,209
Indiana	1,040	1,405,822	1,352	869	1,332,939	1,534	7	2,876	411	1,047	1,408,698	1,345	875	1,335,287	1,526
Kansas	5,039	17,725,692	3,518	4,778	17,022,811	3,563	20	14,465	723	5,059	17,740,157	3,507	4,781	17,024 884	3,561
Kentucky	2,931	2,309,276	788	3,782	3,149,413	833	3	1,666	555	2,934	2,310,942	788	3,782	3,149,413	833
Louisiana	3,638	27,972,877	7,689	3,831	29,289,485	7,645	8	15,618	1,952	3,646	27,988,495	7,676	3,841	29,311,821	7,631
North Louisiana	1,450	5,331,593	3,677	1,543	5,445,656	3,529	6	11,073	1,846	1,456	5,342,666	3,669	1,547	5,452,794	3,525
South Louisiana	2,188	22,641,284	10,348	2,288	23,843,829	10,421	2	4,545	2,273	2,190	22,645,829	10,340	2,294	23,859,027	10,401
*Gulf of Mexico	505	5,173,068	10,244	474	4,867,623	10,269				505	5,173,068	10,244	475	4,868,223	10,249
Michigan	852	3,109,570	3,650	596	1,866,492	3,132	3	3,493	1,164	855	3,113,063	3,641	597	1,866,994	3,127
Mississippi	708	6,944,981	9,809	669	6,291,843	9,405	2	3,838	1,919	710	6,948,819	9,787	676	6,301,876	9,322
Missouri	13	31,861	2,451	14	12,901	922				13	31,861	2,451	14	12,901	922
Montana	324	1,570,996	4,849	342	1,639,710	4,794				324	1,570,996	4,849	345	1,642,053	4,760
Nebraska	926	5,101,070	5,509	825	4,872,812	5,906	2	355	178	928	5,101,425	5,497	825	4,872,812	5,906
New Mexico	1,817	8,997,968	4,952	1,819	7,580,624	4,167	14	31,340	2,239	1,831	9,029,308	4,931	1,829	7,592,319	4,151
Southeast	1,199	6,082,654	5,073	1,015	4,691,142	4,622	9	19,788	2,199	1,208	6,102,442	5,052	1,025	4,702,837	4,588
Northwest	618	2,915,314	4,717	804	2,889,482	3,594	5	11,552	2,310	623	2,926,866	4,698	804	2,889,482	3,594
New York	336	524,822	1,562	273	474,850	1,739				336	524,822	1,562	273	474,850	1,739
North Dakota	273	1,715,525	6,284	433	2,741,670	6,332	5	6,277	1,255	278	1,721,802	6,193	435	2,743,946	6,308
Ohio	1,045	2,557,693	2,447	1,085	2,761,713	2,545	3	3,141	1,047	1,048	2,560,834	2,443	1,100	2,767,581	2,545
Oklahoma	4,537	16,971,324	3,741	5,192	19,137,906	3,686	66	50,456	764	4,603	17,021,780	3,698	5,283	19,203,163	3,635
Pennsylvania	838	2,352,980	2,808	695	2,148,815	3,092	22	11,343	516	860	2,364,323	2,749	712	2,168,694	3,046
South Dakota	18	127,687	7,094	23	168,360	7,320	1	406	406	19	128,093	6,742	23	168,360	7,320
Tennessee	93	78,767	847	107	100,422	939	1	827	827	94	79,594	847	107	100,422	939
Texas	15,050	68,206,484	4,532	17,597	77,636,405	4,412	78	105,924	1,358	15,128	68,312,408	4,516	17,704	77,747,670	4,392
Dist. 1: South Central	1,117	2,891,315	2,588	979	2,587,789	2,643	5	5,914	1,183	1,122	2,897,229	2,582	982	2,590,607	2,638
Dist. 2: Middle Gulf	738	5,007,267	6,785	786	4,910,719	6,248	7	10,098	1,443	745	5,017,365	6,735	790	4,922,583	6,231
Dist. 3: Upper Gulf	1,116	9,454,385	8,472	1,190	8,439,430	7,092	5	6,405	1,281	1,121	9,460,790	8,440	1,191	8,441,730	7,088
*Gulf of Mexico	10	97,783	9,778	5	49,112	9,822				10	97,783	9,778	5	49,112	9,822
Dist. 4: Lower Gulf-S.W.	1,055	5,887,046	5,580	1,308	7,115,371	5,440	11	9,639	876	1,066	5,896,685	5,532	1,316	7,128,749	5,417
*Gulf of Mexico				1	500	500							1	500	500
Dist. 5: East	211	1,039,729	4,928	162	874,843	5,400	3	6,385	2,128	214	1,046,114	4,888	162	874,843	5,400
Dist. 6: Northeast	879	4,716,538	5,366	840	4,628,080	5,510	1	853	853	880	4,717,391	5,361	841	4,628,386	5,503
Dist. 7-B: North Central	2,179	6,520,638	2,992	2,392	7,729,310	3,231	18	24,349	1,353	2,197	6,544,987	2,979	2,399	7,737,067	3,225
Dist. 7-C: West Central	777	3,206,031	4,126	749	3,218,196	4,297	6	3,892	649	783	3,209,923	4,100	754	3,220,709	4,271
Dist. 8: West	2,994	16,982,771	5,672	4,445	22,799,109	5,129	45	27,164	1,811	3,009	17,009,935	5,653	4,497	22,838,702	5,079
Dist. 9: North	2,871	7,528,032	2,622	3,497	9,643,335	2,758	2	4,285	2,143	2,873	7,532,317	2,623	3,519	9,669,361	2,748
Dist. 10: Panhandle	1,113	4,972,732	4,468	1,249	5,690,223	4,556	5	6,940	1,388	1,118	4,979,672	4,454	1,253	5,694,933	4,545
Utah	210	1,191,454	5,674	291	1,623,988	5,581	2	4,732	2,366	212	1,196,186	5,642	292	1,629,884	5,582
Washington	5	26,206	5,241	4	31,928	7,982				5	26,206	5,241	5	32,740	6,548
West Virginia	1,016	2,581,364	2,541	783	2,009,755	2,567	33	34,479	1,045	1,049	2,615,843	2,494	821	2,044,381	2,490
Wyoming	1,038	5,238,364	5,047	898	4,687,227	5,220	15	14,816	988	1,053	5,253,180	4,989	920	4,712,203	5,122
†Other States	31	137,906	4,449	22	124,985	5,681	1	853	853	32	138,759	4,336	22	124,985	5,681
Total United States	46,778	194,583,142	4,160	50,179	206,199,165	4,109	397	439,135	1,106	47,175	195,022,277	4,134	50,660	206,709,182	4,080

STATE or DISTRICT	OIL			DISTILLATE			GAS			DRY			SERVICE WELLS		
	Wells	Footage	Avge. Depth	Wells	Footage	Avge. Depth	Wells	Footage	Avge. Depth	Wells	Footage	Avge. Depth	Wells	Footage	Avge. Depth
Alabama	41	425,411	10,376							11	45,014	4,092			
Alaska	13	145,000	11,154				3	31,174	10,391	7	61,795	8,828	1	3,000	3,000
Arizona	3	18,179	6,060							23	49,288	2,143			
Arkansas	282	853,048	3,025	2	20,738	10,369	34	178,493	5,250	271	1,072,943	3,959	2	4,567	2,283
California	1,116	4,061,417	3,639				114	619,891	5,438	447	2,405,773	5,382	14	58,702	4,193
Colorado	123	611,276	4,970				113	601,580	5,324	457	2,329,105	5,096	1	6,565	6,565
Illinois	774	1,883,711	2,434				6	9,114	1,519	1,142	2,206,669	1,932			
Indiana	309	446,251	1,444				18	22,195	1,233	707	928,529	1,313	6	8,847	4,193
Kansas	2,265	7,677,928	3,390				248	1,123,155	4,529	2,286	8,293,226	3,628	240	631,383	2,631
Kentucky	1,568	1,023,876	653				258	288,604	1,119	1,095	985,798	900	10	10,998	1,100
Louisiana	1,620	11,283,910	6,965	221	2,782,998	12,593	376	2,527,829	6,723	1,421	11,378,140	8,007			
North Louisiana	620	1,785,668	2,880				238	924,175	3,883	592	2,621,750	4,429			
South Louisiana	1,000	9,498,242	9,498	221	2,782,998	12,593	138	1,603,654	11,621	829	8,756,390	10,563			
*Gulf of Mexico	271	2,558,508	9,441	42	503,549	11,989	32	360,944	11,280	160	1,750,067	10,938			
Michigan	368	1,385,235	3,764				33	105,878	3,208	438	1,597,338	3,647	13	21,119	1,624
Mississippi	308	3,176,446	10,313	9	97,161	10,796	34	369,603	10,871	357	3,301,771	9,249			
Missouri	2	3,610	1,805				1	409	409	10	27,842	2,784			
Montana	119	714,735	6,006				8	22,014	2,752	195	822,468	4,218	2	11,779	5,889
Nebraska	281	1,468,939	5,227				1	5,143	5,143	643	3,621,557	5,632	1	5,431	5,431
New Mexico	1,005	4,939,397	4,915				393	2,213,094	5,631	409	1,832,601	4,481	10	12,876	1,288
Southeast	834	4,255,320	5,102				37	263,735	7,128	325	1,556,649	4,790	3	6,950	2,317
Northwest	171	684,077	4,000				356	1,949,359	5,476	84	275,952	3,285	7	5,926	846
New York	180	223,202	1,240				36	85,860	2,385	36	111,600	3,100	84	104,160	1,240
North Dakota	154	1,010,382	6,561							118	702,340	5,952	1	2,803	2,803
Ohio	464	1,117,283	2,408				258	753,688	2,921	310	679,662	2,192	13	7,060	543
Oklahoma	2,287	8,131,016	3,555	91	714,471	7,851	351	2,009,210	5,724	1,432	5,476,243	3,824	376	640,384	1,703
Pennsylvania	281	488,434	1,738				236	1,007,690	4,270	91	439,723	4,832	230	417,133	1,814
South Dakota	7	59,920	8,560							11	67,767	6,161			
Tennessee	8	4,318	540				4	2,695	674	81	71,754	886			
Texas	7,875	32,016,936	4,066	425	3,807,886	8,960	1,103	6,583,773	5,969	5,437	25,295,272	4,652	210	502,617	2,393
Dist. 1: South Central	561	1,154,075	2,057	16	141,548	8,847	29	134,517	4,638	505	1,456,247	2,884	6	4,928	821
Dist. 2: Middle Gulf	163	1,153,249	7,075	129	1,098,126	8,513	127	615,928	4,850	319	2,139,964	6,708			
Dist. 3: Upper Gulf	476	2,568,990	5,397	130	1,310,169	10,078	56	375,915	6,713	454	5,199,311	11,452			
*Gulf of Mexico	1	9,099	9,099							9	85,684	9,520			
Dist. 4: Lower Gulf-S.W.	292	1,293,451	4,430	134	1,125,777	8,401	151	866,317	5,737	478	2,601,501	5,442			
*Gulf of Mexico															
Dist. 5: East	25	138,329	5,533	5	37,045	7,409	23	152,946	6,650	158	711,409	4,503			
Dist. 6: Northeast	531	2,600,040	4,896	3	30,227	10,076	60	480,807	8,013	284	1,599,364	5,632	1	6,100	6,100
Dist. 7-B: North Central	1,031	3,062,642	2,970				124	442,855	3,571	1,000	2,960,570	2,961	24	54,571	2,274
Dist. 7-C: West Central	440	1,814,452	4,124	1	4,818	4,818	36	218,114	6,059	296	1,158,443	3,914	4	10,204	2,551
Dist. 8: West	2,231	12,322,571	5,523				114	1,280,899	11,236	563	3,139,699	5,577	86	239,602	2,786
Dist. 9: North	1,545	3,648,796	2,362				109	659,059	6,046	1,136	3,047,628	2,683	81	172,549	2,130
Dist. 10: Panhandle	580	2,260,341	3,897	7	60,176	8,597	274	1,356,416	4,950	244	1,281,136	5,250	8	14,663	1,833
Utah	99	587,503	5,934				19	104,231	5,486	92	499,720	5,432			
Washington										5	26,206	5,241			
West Virginia	218	459,410	2,107				677	1,759,134	2,598	119	354,335	2,978	2	8,485	4,243
Wyoming	463	2,321,122	5,013	2	18,899	9,450	52	311,084	5,982	506	2,539,821	5,019	15	47,438	3,162
†Other States							3	21,384	7,128	28	116,522	4,161			
Total United States	22,233	86,537,895	3,892	750	7,442,153	9,923	4,379	20,756,925	4,740	18,185	77,340,822	4,253	1,231	2,505,347	2,035

* Gulf of Mexico wells are included in their respective districts. † Other states include: Florida, Georgia, Idaho, Maryland, Nevada, North Carolina, Oregon, and Virginia.

U.S. rig activity down 11.2 percent

FOLLOWING A SIX-YEAR downward trend in activity, the number of drilling rigs operated in the United States dropped to an 18-year low during 1960. An average of 3,543 rigs was operating monthly last year, the lowest since the days of drastic government limitations during World War II.

This was 448, or 11.2 percent fewer rigs than the 3,991 operated monthly during 1959, and 571 less than the monthly average of 4,114 rigs reported during 1958.

Little encouragement was to be gained from last year's second half trends, usually a period that shows some improvement. From July through December, monthly totals averaged 481 rigs below the same 1959 period, while the totals for the previous six months averaged 399 rigs behind the 1959 pace.

At one time during the year, 676 fewer rigs were operating than at the corresponding date in 1959. That was at the end of June, when 3,554 rigs were operating, compared with 4,230 in 1959.

The only states reporting significant increases in rig activity last year were West Virginia with 165 rigs operating per month, up 30 rigs per month over 1959; Indiana, 120 rigs per month, up 31 rigs; and Michigan, 113 rigs per month, up 20 rigs. Colorado activity increased 16 rigs per month, from 55 rigs in 1959, to 71 last year.

Texas reported the biggest drop in activity, averaging 849 rigs per month, down 187 rigs monthly from 1959. In comparison, Louisiana activity dropped 30 rigs per month, to 321; Kansas' monthly average dropped 57 rigs per month, to 236.

Average Number of U.S. Drilling Rigs in Operation, by States

(Note: For data at end of each month, by states, see regular issues of WORLD OIL.)

State or District	1960	1959
Alabama	**6**	**11**
Alaska	**6**	**5**
Arizona	**6**	**6**
Arkansas	**38**	**45**
California	**120**	**138**
Colorado	**71**	**55**
Illinois	**259**	**275**
Indiana	**120**	**89**
Kansas	**236**	**293**
Kentucky	**133**	**168**
Louisiana	**321**	**351**
North Louisiana	63	62
South Louisiana	258	289
*Gulf of Mexico	56	53
Michigan	**113**	**93**
Mississippi	**67**	**74**
Missouri	**1**	**2**
Montana	**28**	**44**
Nebraska	**34**	**35**
New Mexico	**140**	**167**
New York	**25**	**25**
North Dakota	**18**	**35**
Ohio	**158**	**211**
Oklahoma	**426**	**472**
Pennsylvania	**63**	**53**
South Dakota	**2**	**3**
Tennessee	**23**	**25**
Texas	**849**	**1,036**
Dist. 1: South Central	35	38
Dist. 2: Middle Gulf	53	53
Dist. 3: Upper Gulf	91	95
*Gulf of Mexico	1	1
Dist. 4: L. Gulf-S.W.	70	81
Dist. 5: East Central	15	12
Dist. 6: Northeast	63	55
Dist. 7-B: N. Central	84	98
Dist. 7-C: W. Central	68	68
Dist. 8: West	177	287
Dist. 9: North	122	157
Dist. 10: Panhandle	71	92
Utah	**35**	**39**
Washington	**1**	**1**
West Virginia	**165**	**135**
Wyoming	**74**	**95**
Others	**7**	**9**
Total, U.S.	**3,543**	**3,991**

*** State district data include offshore operations.**

Drilling Rigs in Use in United States, by Years, by Months

Figures are for end of month, and include rigs drilling, rigging up, and shut down

YEAR	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg. for Year
1938	3,968	3,928	3,973	3,971	3,582	4,830	3,737	3,869	3,742	3,876	3,676	3,434	3,799
1939	3,583	3,391	3,448	3,630	3,695	3,726	3,567	3,718	3,625	3,905	3,981	3,924	3,683
1940	3,990	4,277	4,472	4,327	4,655	4,502	4,235	4,194	3,821	3,921	4,030	3,894	4,193
1941	3,814	3,952	4,121	4,287	4,335	4,598	4,819	4,984	4,693	4,672	4,746	4,336	4,446
1942	3,816	3,067	2,979	2,859	2,868	2,905	3,179	3,007	2,953	3,094	2,962	2,797	3,041
1943	2,691	2,653	2,732	2,756	2,743	2,852	3,015	3,201	3,031	3,548	3,676	3,595	3,041
1944	3,427	3,568	3,702	3,819	3,934	4,278	4,411	4,528	4,566	4,738	4,665	4,640	4,190
1945	4,270	4,154	4,159	4,374	4,637	4,394	4,424	4,289	4,356	4,521	4,426	4,637	4,387
1946	4,337	4,229	4,212	4,405	4,399	4,124	4,235	4,201	4,474	4,410	4,551	4,654	4,353
1947	4,390	4,402	4,379	4,470	4,603	4,802	4,992	5,163	4,979	4,897	4,871	4,945	4,741
1948	4,699	4,542	4,626	4,989	5,067	5,090	5,013	5,058	5,116	5,229	5,060	4,908	4,950
1949	4,511	4,490	4,368	4,265	4,276	4,097	4,015	4,118	4,258	4,247	4,485	4,355	4,290
1950	4,180	4,169	4,114	4,224	4,518	4,760	4,712	4,804	4,633	4,773	4,649	4,665	4,517
1951	4,275	4,339	4,435	4,600	4,831	4,762	4,989	4,988	5,237	5,260	5,234	5,182	4,844
1952	5,010	5,015	5,092	5,093	5,151	5,037	4,694	4,508	4,687	4,659	4,689	4,649	4,857
1953	4,585	4,585	4,611	4,661	4,693	4,935	4,878	4,997	4,879	4,939	5,047	4,802	4,784
1954	4,597	4,743	4,732	4,709	4,716	4,656	4,616	4,439	4,467	4,581	4,685	4,680	4,635
1955	4,502	4,456	4,683	4,713	4,816	4,997	4,965	5,019	4,987	5,124	5,160	4,987	4,867
1956	4,597	4,677	4,883	4,886	5,019	5,019	4,775	4,819	4,828	4,865	4,882	4,885	4,845
1957	4,625	4,582	4,621	4,749	4,868	4,930	4,983	4,945	4,887	4,844	4,889	4,569	4,791
1958	4,153	3,936	3,813	3,959	3,946	3,970	4,082	4,201	4,118	4,338	4,410	4,445	4,114
1959	3,813	3,661	3,913	3,960	4,109	4,230	4,160	4,144	4,083	3,943	3,985	3,894	3,991
1960	3,702	3,390	3,531	3,539	3,574	3,554	3,406	3,573	3,631	3,482	3,621	3,511	3,543

New world's depth record a possibility in 1961

ALTHOUGH WEST TEXAS still holds the world's depth record, Louisiana stands a good chance to capture the honors in 1961.

John W. Mecom Unit SLL&E State Lease 2435-2414 No. 1, a 26,000-foot test, was drilling below 12,200 feet early in February. The well, drilling in Lake Washington field, Plaquemines Parish, Louisiana, will become the world's deepest well if projected depth is reached.

The current titleholder is Phillips Petroleum Company's University EE-1, in Pecos County, Texas, which was drilled to 25,340 feet in 1958.

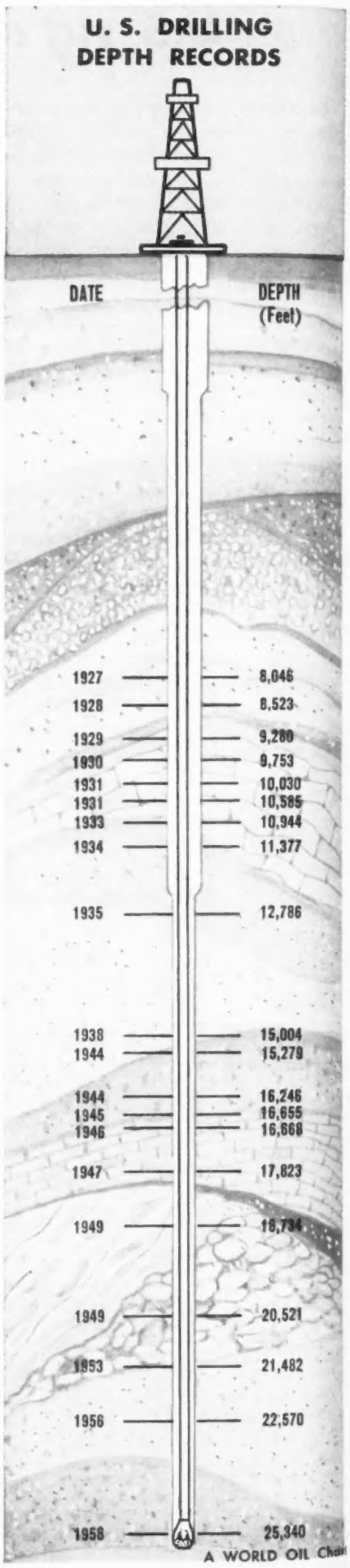
The nation's 46 drilling areas reported only four depth records during 1960—the smallest number in recent years. In comparison, nine records were broken in 1958 and 10 in 1957.

The deepest well drilled during 1960 was Hunt Oil Company's J. O. Walker 1, in Webb County, southwest Texas. The well reached total depth in the Edwards limestone at 20,603 feet. The previous record holder in southwest Texas was Shell Oil Company's William M. Carroll 1, wildcat drilled 16 miles east-northeast of Cuero in Dewitt County. The well was drilled to 19,765 feet in the Edwards during 1959.

A new depth record was set in the South Louisiana offshore area last year, when Hunt Oil Company's No. 1, OCS 0426 reached 19,061 feet in the Eugene Island Block 77 field. The earlier record was held by Hunt Oil's No. 2 State Lease 758, block 39, in the Ship Shoal area's Coon Point field, which was drilled to 18,002 feet in 1957.

In the North Texas and Panhandle area, Grande Corporation's Harsh-Barger 1 in Grayson County reached total depth of 18,008 feet, breaking the record set in 1958 when the Max Pray's Mills 1, in Wheeler County, reached total depth of 16,156 feet.

Illinois' eight-year-old depth record



Holders of Record as Deepest Test Drilled

(Includes Both Dry and Producing Wells)

Year	Company, Well and Location	Feet
1927	Chansler-Canfield-Midway Oil Co.'s Olinda 96, Olinda, California	8,046
1928	Texon Oil and Land Co.'s University 1-B, Big Lake, West Texas	8,523
1929	Shell Oil Co.'s Nesa 1, Long Beach, California	9,280
1930	Standard Oil Company of California's Mascot 1, Midway, California	9,753
1931	Chansler-Canfield-Midway Oil Co.'s Hobson A-2, Rincon field, Ventura County, Calif.	10,030
1931	Penn-Mex Fuel Co.'s Jardin 35, State of Vera Cruz, Mexico	10,585
1933	North Kettleman O. & G. Co.'s (later Union Oil's Lillis-Welch 1) Kettleman Hills, Calif.	10,944
1934	General Petroleum Corp.'s Berry 1, Belridge, Kern County, California	11,377
1935	Gulf Oil Corp.'s McElroy 103, Gulf-McElroy, Upton County, W. Texas	12,786
1938	Continental Oil Co.'s KCL A-2, Wasco, Kern County, California	15,004
1944	Phillips Petroleum Co.'s Price 1, Wildcat, Pecos County, West Texas	15,279
1944	Standard Oil Co. of California's KCL 20-13, South Coles Levee, Kern County, California	16,246
1945	Phillips Petroleum Co.'s Schoeps 3, Wildcat, Brazos County, Gulf Coast, Texas	16,655
1946	Pacific Western Oil Corp.'s National Royalties 1, Miramonte area, Kern County, Calif.	16,668
1947	Superior Oil Company of California's Weller 51-11, Wildcat, Caddo County, Okla.	17,823
1949	Superior Oil Company of California's Limoneria 1, Wildcat, Ventura County, Calif.	18,734
1949	Superior Oil Company of California's Unit 1, Wildcat, Sublette County, Wyoming	20,521
1953	Ohio Oil Co.'s Kern County Lands "A" 72-4, Paloma field, Kern Co., California	21,482
1956	Richardson & Bass, Freeport Sulphur & J. W. Mecom's Humble-L.L.&E. 1-L, Plaquemines, S. Louisiana	22,570
1958	Phillips Petroleum's University EE-1, Wildcat, Pecos County, West Texas	25,340

was broken in 1960 by the Humble Oil Weaber-Horn 1, in Fayette County, which was drilled to a total depth of 8,616 feet. In 1952, Superior Oil Company's H. C. For et al 017, in White County, set the previous record at 7,582 feet.

Greater depth areas. Thirty-two or nearly 70 percent, of the 46 oil and gas drilling areas in the United States have had drilling below 10,000 feet. Of the areas reporting such depths, seven have had wells drilled below 20,000 feet, two report wells in the 19,000-20,000-foot category, one between 18,000 and 19,000 feet, while two areas have 17,000 to 18,000-foot wells.

Eleven years ago, the first well was drilled below 20,000 feet. It was Superior Oil Company's Unit 1 in Sublette County, Wyoming. The 20,521-foot well still holds the depth record in Wyoming.

Regional Drilling Depth Records in United States

State or District	Total Depth	Year	WELL AND LOCATION	Formation
West Texas	**25,340**	1958	Phillips Pet. Co's University EE-1, wildcat, Pecos County	Ellenburger
Oklahoma	**24,014**	1958	Shell's Rumberger 5, Elk City field, Becham County	Springer-Pennsylvanian
S. La.-Inshore	**22,570**	1956	Richardson & Bass et al's Humble-LL&E 1-L, Plaquemines Parish	Miocene
California	**21,482**	1955	Ohio Oil's KCL "A" 72-4, Paloma field, Kern County	L. Miocene
Southwest Texas	**20,603**	1960	Hunt Oil Company's J.O. Walker 1, Webb County	Edwards
Wyoming	**20,521**	1949	Superior of Calif.'s Unit 1, Pacific Creek area, Sublette County	U. Cretaceous
Mississippi	**20,450**	1956	George Vasen et al's Fee 1, 9-2s-11w, Stone County (Salt, Jurassic)	Eagle Mills
S. La.-Offshore	**19,061**	1960	Hunt Oil's No. 1, OCS 0426, Eugene Island Block 77 field	Miocene
Texas Gulf Coast	**19,056**	1955	Socony Mobil's West Ranch 417-A, West Ranch field, Jackson County	Cockfield
N. Tex. & Panhandle	**18,008**	1960	Grande Corp's Harsh-Barger 1, Grayson County	Ordovician
N. Mex. S.E.	**17,555**	1958	Shell's James Ranch Unit 1, wildcat, Eddy County	Ellenburger
Colorado	**17,033**	1957	Phillips Petroleum's Mannel 1, 26-1n-95w, Rio Blanco County	Weber
East Texas	**16,347**	1949	Humble's R.P. McWatters 1, Freestone County	Jurassic
Alabama	**15,729**	1952	Humble's Emma Williams 1, 10-3n-2e, Clarke County	Jurassic
Florida	**15,455**	1947	Gulf's State of Florida, 1, Big Pine Key area, Monroe County	L. Cretaceous
North Dakota	**15,135**	1959	Amerada's Antelope Unit 1-A, 1-152n-95w, McKenzie Co. Testing at end 1959	Cambrian
Alaska	**15,047**	1959	Union & Ohio's Union-Ohio Kenai Unit 1, 6-4n-11w	.....
North La.	**14,967**	1947	Cotton Valley Opr. Comm. et al's A.G. Oliphant Banks 2, Webster Parish	Salt
Montana	**13,830**	1956	Phillip's Northern Pacific RR 1-A, 33-9s-21e, Carbon County	Madison
Utah	**13,766**	1949	Pacific Western Oil & Equity Oil's Unit 1, 33-21s-21e, Grand County	Pennsylvanian
N. Mex. N.W.	**13,590**	1956	Magnolia's Jicarilla 1-A, 18-23n-2w, Rio Arriba County	Granite
New York	**13,500**	1958	New York State Nat. Gas' Woodhull Twp., Steuben County	Sub-Postdam
West Virginia	**13,331**	1955	Hope Natural Gas Co.'s Power Oil Co. 9634, Walker dist. Wood County	Pre-Cambrian
Kentucky	**13,170**	1959	United Fuel Gas Co.'s James 1, Martin County	.....
Arkansas	**12,925**	1957	Hunt Oil's R.B. McDonald, 1-20s-21w, Columbia County	Salt
Oregon	**12,880**	1956	Sinclair's Federal-Mapleton 1, 12-16s-10w, Lane County	Eocene
Idaho	**12,844**	1951	Phillips & Utah Southern's Unit 1, 10-14s-30e, Oneida County	.....
Pennsylvania	**12,343**	1951	California Co.'s Bennett 1, Davidson Twp., Sullivan County	Ordovician
Nevada	**11,543**	1952	Continental & Standard's Summit Springs Unit 1, 32-20n-60e, White Pine Co.	Mississippian
Michigan	**11,012**	1948	Ohio Oil-Pure Oil's Reinhardt 1, West Branch field, Ogemaw County	Cambro-Ord.
Washington	**11,002**	1947	Standard of Calif.'s Alderwood Comm. 1 Snohomish County	Mid. Eocene
North Carolina	**10,054**	1946	Standard of New Jersey's Cape Hatteras 1, Dare County	Granite
Virginia	**9,936**	1949	The California CO.'s Kipps Anthracite Coal Co. 1, Montgomery County	Ordovician
South Dakota	**9,348**	1951	Shell Oil Co.'s J.T. Homme 1, 13-20n-12e, Perkins County	Eocene
Nebraska	**8,875**	1957	Shell's Schnieder 2, 26-15n-56w, Heidemann field, Kimball County	Pre-Cambrian
Illinois	**8,616**	1960	Humble's Weaber-Horn 1, Fayette County	Granite
Kansas	**8,243**	1947	Pan American's (Stanolind's) Feathers 1, 15-35s-33w, Seward County	.....
Maryland	**8,165**	1941	William Snee's Schartzer 1, Accident Dist., Garrett County	Helderburg
Ohio	**7,889**	1933	Benedum & Tree's Knowlton 1, Independence Twp., Washington County	Clinton
Georgia	**7,613**	1958	J.R. Sealy's Lena Rebecca Sealy 3, Seminole County	L. Cretaceous
Arizona	**7,568**	1954	Arizona Oil & Gas Co.'s State 1, Cochise County	Pennsylvanian
Indiana	**6,806**	1959	Indiana Farm Bureau's Luther Brown 1, 20-5n-2e, Lawrence County	Granite
Tennessee	**5,750**	1947	The California Co,'s E.W. Beeler 1, 4-15s-29e, Giles County	Granite
Iowa	**5,305**	1930	Oil Development Co.'s Wilson 1, Page County	Cambrian
New Jersey	**5,022**	1928	W&K Oil Co.'s Well 1, Jackson Mills area, Ocean County	Granite
Missouri	**4,740**	1941	Strake Petroleum Co's T.P. Russell 1, Pemiscot County	Cambrian

Advancements in production methods—1960

By R. W. Scott
Engineering Editor WORLD OIL

MANY NEW PRODUCTION techniques and tools were introduced during 1960. As in previous years, chief interest was devoted to reducing production costs and increasing operational efficiency. This article will review several of the major oil industry achievements in production for the year 1960.

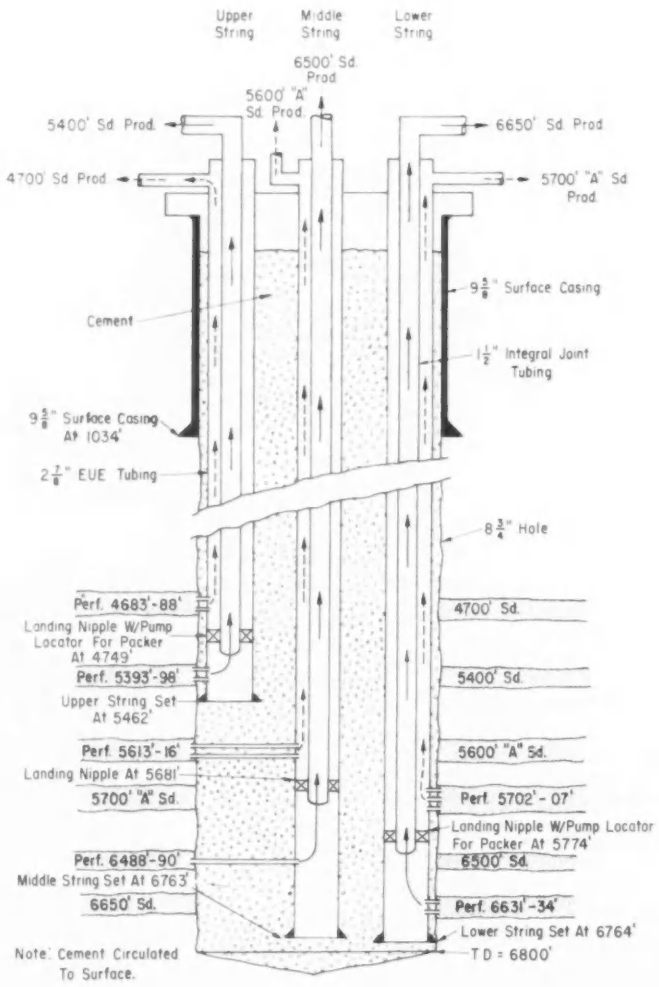


FIGURE 1—World's first sextuple producing well was completed in 1960 using small diameter completion technique. Three strings of 2⅞-inch casing were run in 8¾-inch hole.

WELL COMPLETIONS

Small diameter wells. Successful size reduction of both surface and subsurface equipment has made possible true well miniaturization. Almost every item of downhole test, completion and producing equipment now has been reduced in size and is available for use in small diameter wells.

Some wells now are being equipped with 2⅞-inch casing, a small tubing string and, if artificial lift is required, a string of half-inch rods. This refinement of the original "tubingless" completion technique (where flow was through the "casing" or a hollow rod string) affords adequate protection for the small diameter casing string. Casing wear due to rod abrasion is reduced and well fluids are not allowed to contact the pipe and cause corrosion failures. However, capital investment is increased due to the additional tubing string.

In some areas, deep producing depths prevent use of the method because of the limitations of small diameter rod strings. In these cases, some operators have installed 4½-inch casing and larger tubing and rod strings. Because of increased working space, the larger casing has also become popular in areas where frequent workovers are required.

Industry's first sextuple well was completed in 1960 by Sunray Mid-Continent Oil Company using the small diameter casing concept (Figure 1). Three strings of 2⅞-inch casing were run in a single hole and equipped with 1½-inch tubing strings and packers, thus providing three "old style" dual producing wells. The same operator recently ran four 2⅞-inch casing strings in a single hole. Multiple completions were not made in each of the strings as was the case in the sextuple well. However, it is obvious that the procedure is applicable to completing eight zone producers if proper reservoir conditions exist.

Stekoll Petroleum Company has successfully applied the technique to secondary recovery operations. Small cased wells will handle satisfactory water volumes at depths flooded most frequently. Stekoll estimates savings of as much as 25 percent on producing wells and 30 percent on injection wells as compared to conventional completions.

Economic advantages of small diameter wells are ap-

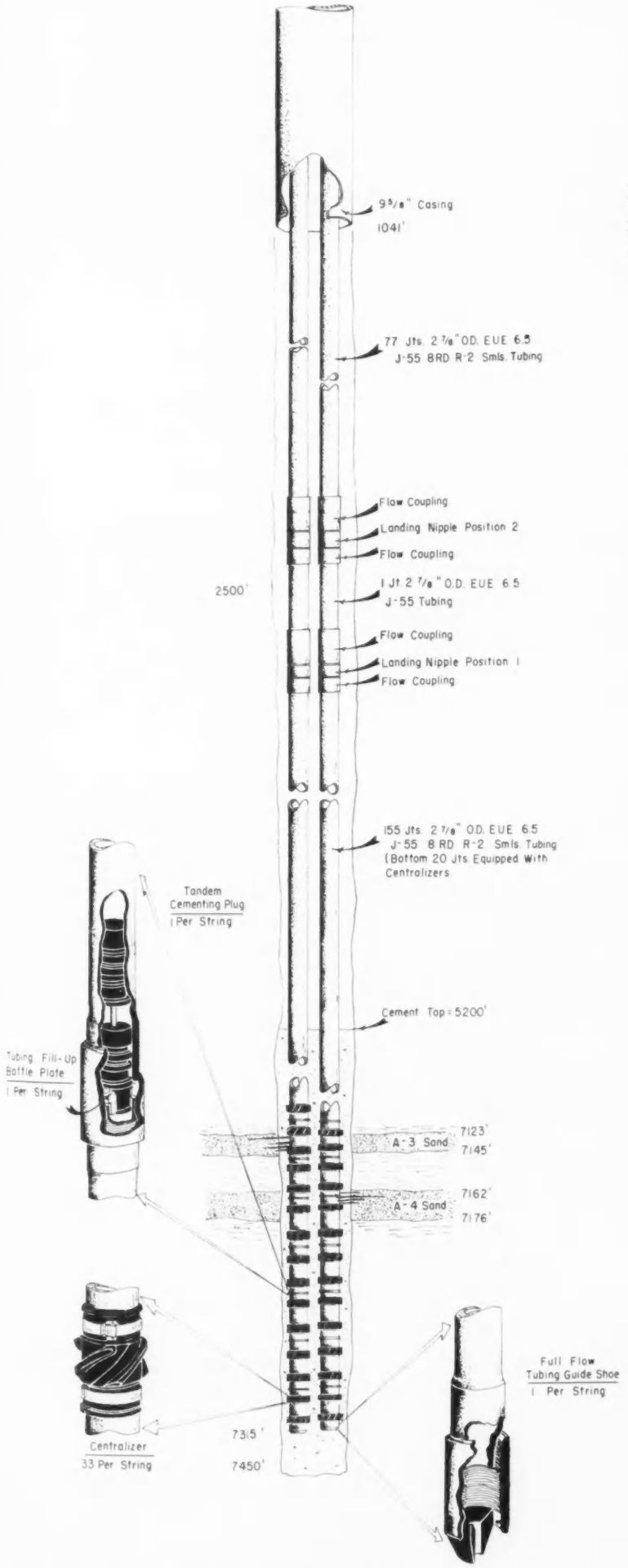


FIGURE 2—Successful primary cement jobs were obtained on multiple tubingless wells equipped as shown. Both strings were reciprocated during cementing.

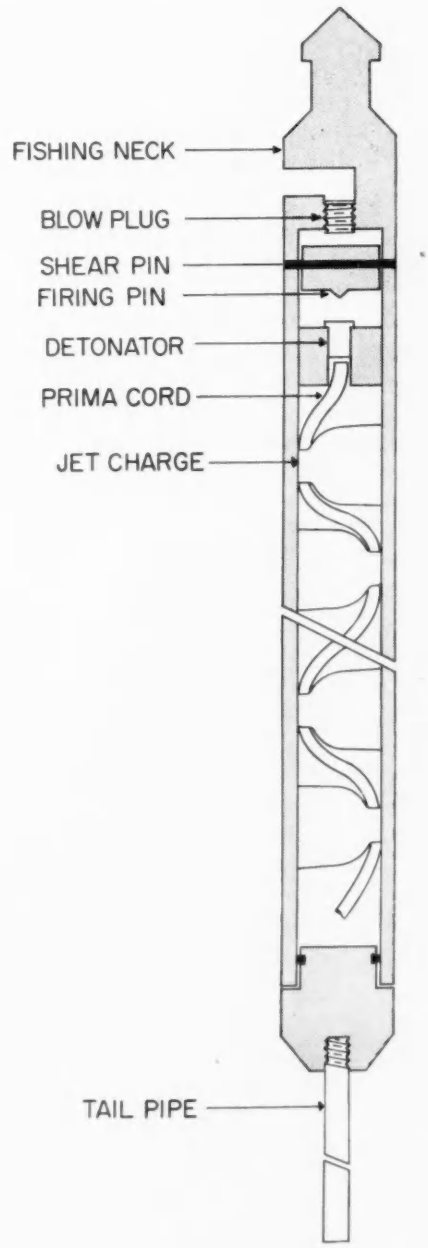


FIGURE 3—"Free" perforator can be set in hole on piano wireline. Increase in pressure acting on blow plug causes gun to fire.

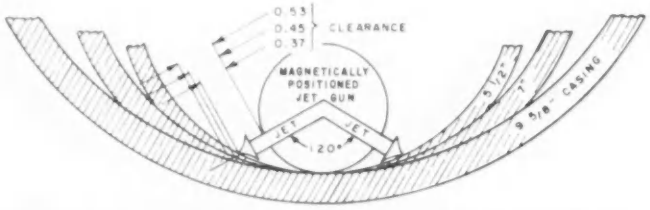


FIGURE 4—Magnetically positioned perforating gun adheres to casing wall assuring optimum placement of shots. Drawing shows clearances in different sizes of casing.

parent; however, these can be offset if serious completion problems arise.

Good primary cement jobs, especially on multiple wells, have been difficult to obtain. Phillips Petroleum Company has had considerable experience with the problem. It was found that difficulties could at least be minimized by:

- Running centralizers from the shoe through the pay zones.
- Reciprocating strings while cementing.
- Cementing with high annular velocities using individual pumping units on each string.
- Using low viscosity wash solutions ahead of the cement. A typical hookup for a good cement job on a 7,500-foot Gulf Coast dual well is shown in Figure 2.

Perforating of multiple tubingless wells also has presented a problem, although new tools and techniques have helped provide better results.

More powerful perforating guns and application of the sand abrasion jet perforating technique has improved penetration of the thick cement sheath surrounding the pipe. In addition, better orientation techniques have lessened the possibility of perforating adjacent casing strings.

As an added measure, some operators run an odd length casing joint (pup joint) near the pay zone to assist in identifying gamma ray collars. Also, at least 50 feet of pipe is run below the pay zone to provide adequate "rat hole" for lost tools, etc.

Although the small diameter well completion technique presented a number of serious problems initially, developments have kept pace and most difficulties at least have been minimized. Expanded work in this field is a certainty due to the many economic advantages afforded.

Conventional completions. Sinclair Oil and Gas Company completed the first quintuple well utilizing five strings of tubing in 1960. The quintuple packer and wellhead assembly were manufactured especially for the job. Other equipment consisted of stock items used previously on multiple completed wells.

Subsea well. The first underwater completion in deepwater was installed off the coast of Peru last year. Cities Service Oil Company and Richfield Oil Corporation completed the well in 132 feet of water approximately 6,200 feet from shore. At the time this article was written, the operators had not released any detailed technical information concerning the well. It is thought that currently available subsea completion equipment with some modifications was used. Additional wells are expected to be completed in the near future.

Nitrogen. Use of nitrogen in producing operations has increased appreciably and development of vacuum type

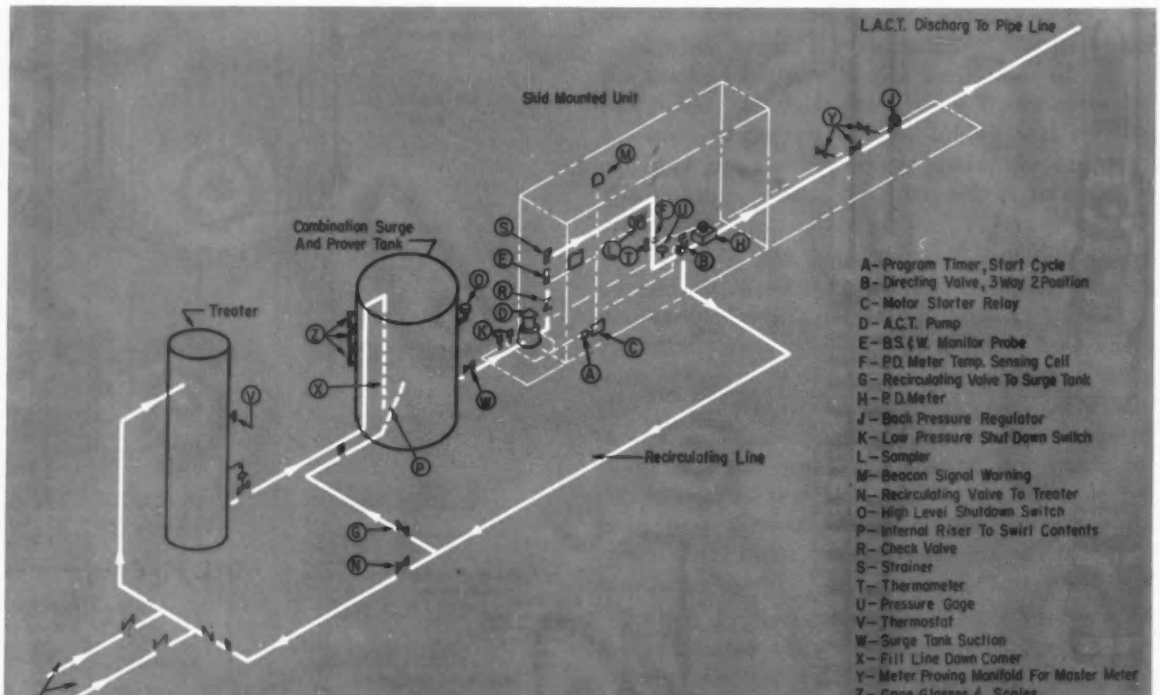

L.A.C.T. Discharg To Pipe Line
Skid Mounted Unit
Combination Surge And Prover Tank
Treater
Recirculating Line
Lease Production From Wells
A- Program Timer, Start Cycle
B- Directing Valve, 3 Way 2 Position
C- Motor Starter Relay
D- A.C.T. Pump
E- B.S.&W. Monitor Probe
F- P.D. Meter Temp. Sensing Cell
G- Recirculating Valve To Surge Tank
H- P.D. Meter
J- Back Pressure Regulator
K- Low Pressure Shut Down Switch
L- Sampler
M- Beacon Signal Warning
N- Recirculating Valve To Treater
O- High Level Shutdown Switch
P- Internal Riser To Swirl Contents
R- Check Valve
S- Strainer
T- Thermometer
U- Pressure Gage
V- Thermostat
W- Surge Tank Suction
X- Fill Line Down Corner
Y- Meter Proving Manifold For Master Meter
Z- Gage Glasses & Scales

FIGURE 5—Skid mounted, PD meter equipped LACT units installed on small leases (30-700 bopd) have proven more economical than similar units serving large leases.

transport units now permits delivery of gas volumes to 175 Mcf at pressures to 10,000 psi at the wellhead. Chief use of the gas has been as a displacement medium for wells on completion.

Wells also have been treated with corrosion inhibitor, surfactants and paraffin solvents using nitrogen as the carrying medium. Other applications include:

1. Perforating. Tubing is displaced with gas under pressure and the well is perforated through tubing with minimum danger of blowing the gun up the hole. Also, the well then can be completed under complete control through a choke.

2. Fracturing and acidizing. Acid, fracture fluid and flush oil may be aerified when pumped into the well. Well then can be recompleted without swabbing because of lightened hydrostatic head.

3. Cementing. Use of nitrogen in mud prior to cementing assures placement of cement in lost circulation areas. The nitrogen reduces the hydrostatic head above the cement column on the outside of the casing thus allowing proper fillup of cement.

LOGGING AND PERFORATING

Cement bond log. A new logging method for evaluating casing cement jobs has proven extremely valuable in recent months. The new log not only indicates the top of cement behind pipe, but also provides an indication of the variation in cementation quality below the top. Poor cement jobs indicated by the log have been confirmed by production and formation test results.

The new log operates on the principle that the attenuation of a sonic pulse transmitted by a casing is greatly increased when that casing is bonded to an outer annulus of set cement which has a sonic wave velocity substantially less than that of the pipe.

The downhole tool contains a source of recurrent sound pulses which are detected by a receiver spaced a few feet from the source. The amplitude of the detected pulse is measured and the resulting signal is transmitted to the surface where it is recorded versus depth. Amplitude is a function of attenuation and the log thus is readily interpreted.[6]

The log should have wide application in evaluating cement job quality prior to testing in new completions and workover jobs.

Hydrostatic perforator. A new perforating gun which is actuated by an increase in hydrostatic pressure and remains in the hole after firing was used successfully in 1960 (Figure 3).

The tool is a completely "free" perforating unit since no shooting line is required for detonation. A piano wireline unit may be used to run the gun in the well. The perforator can be placed in the proper position by two methods:

1. The hanger portion of a through-tubing bridge plug is attached to the gun which then is run on wireline and hung opposite the zone to be perforated.

2. A tail pipe of proper length may be attached to the bottom of the gun. If the zone to be perforated is near the bottom of the hole, the tool with tail pipe is run on wireline and set on bottom.

The gun is actuated by a blow plug which shears at a given increase in pressure (See Figure 3). When this pressure is attained, the plug ruptures allowing full pressure to act against the firing pin or piston. This causes the piston to shear the retaining pin and slam the firing pin into the detonator. This, in turn, ignites the prima cord and detonates the individual charges. All debris is contained in the steel gun tube which can be left in the well or retrieved by wireline at a future date.

Magnetic perforator. Magnetically positioned perforating equipment has improved efficiency of small through-tubing capsule-type guns. The new tool is equipped with a permanent magnet which causes the gun to adhere to the casing wall opposite the zone to be shot.

Charges are positioned so that they fire in two directions at a divergence of 120°. This results in the charges being located an optimum distance from the casing wall upon detonation. For example, charges in a magnetically positioned $1\frac{11}{16}$-inch capsule gun are positioned only 0.37 inch from the wall of $5\frac{1}{2}$-inch casing and 0.53 inch from $9\frac{5}{8}$-inch casing (Figure 4). As a result, constant perforating quality is maintained over the producing interval.

WELL STIMULATION

Aluminum particles prop fractures. The Atlantic Refining Company and Pan American Petroleum Corporation recently developed a new malleable aluminum fracture propping agent which resists crushing and tends to deform under loading. The deformation increases bearing area against the formation wall and reduces particle penetration into the formation.

It has been found that fracture flow capacity can be increased by sparcely packing the induced crack with propping agents. However, capacity can be reduced by crushed propping agents or penetration of the agent into the formation wall. Since the aluminum particles will only deform, they provide a definite advantage in this respect.

Field results have shown that the aluminum agent provides better stimulation than conventional fracturing agents where high conductivity fractures are required.

Sand has been used in conjunction with aluminum since stimulation sometimes can be achieved at lower cost by using a minimum quantity of pellets. In other cases, sand serves as a safety factor. If the aluminum does not produce anticipated results, stimulation will be at least as great as for a conventional fracture job.[7]

Implosion capsules. Hollow gas capsules spotted opposite the producing formation have been collapsed or "imploded" by hydrostatic head plus pressure obtained with surface pumping equipment to improve fracturing performance. The technique has been particularly successful in dense, tight pay zones.

As the capsule implodes, the inward rush of fluid into the void space previously occupied by the capsule pulls debris from the formation and provides a cleaning action for the perforations and sand face. A high pressure surge of short duration follows the implosion and initiates fractures in the producing interval. A conventional fracture job then is performed.

The technique provides the following advantages:

1. Conventional fracture treatments are performed at lower surface pressures.

2. More propping agent can be injected into the formation at higher rates.

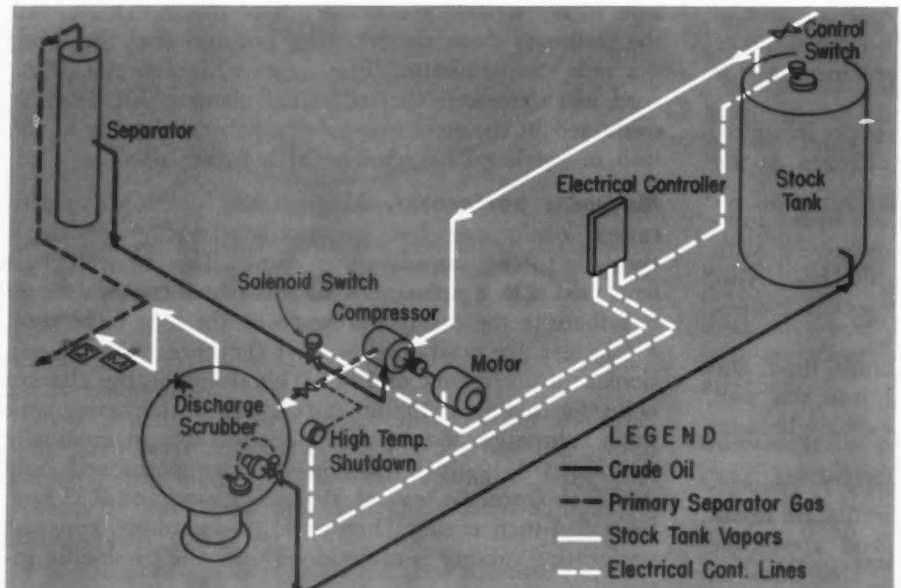


FIGURE 6—Installation of small compressor units to recover rich stock tank vapors converts a total loss into an attractive source of revenue. Here is a typical West Texas installation.

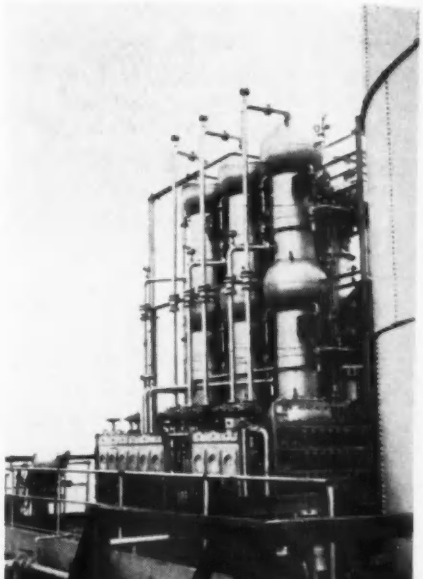


FIGURE 8—"Compacted" separation equipment is essential on marine locations to conserve platform space. Unit shown contains 15 separators.

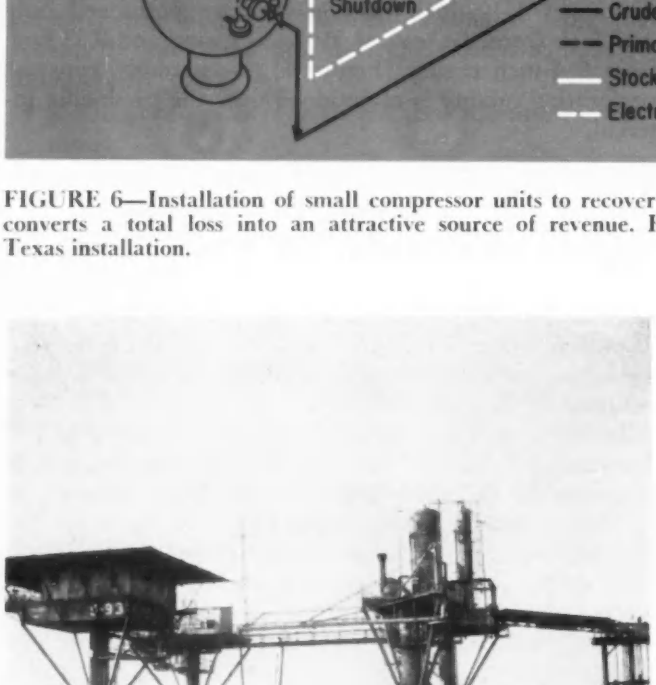


FIGURE 7—First underwater oil storage unit for offshore service became operational in 1960. Unit has 20,000-barrel storage capacity.

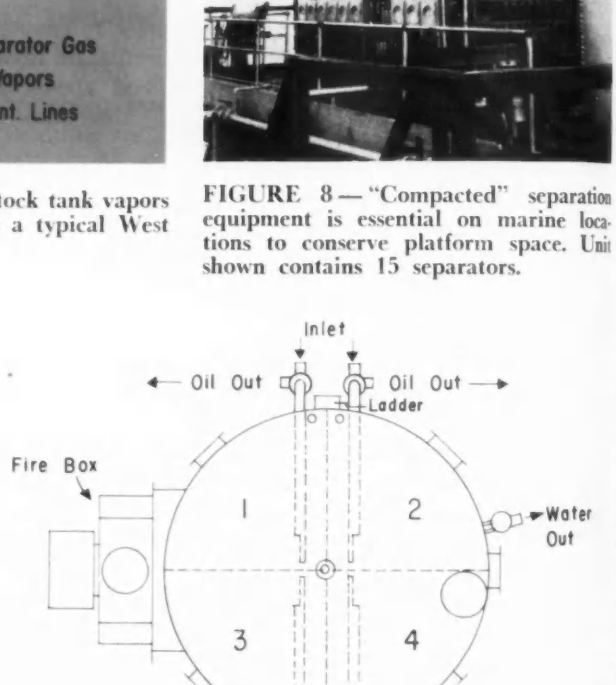


FIGURE 9—Single 10-foot x 32-foot, 4-compartmented heater treater with single fire tube is equivalent to four 6-foot x 20-foot vessels.

3. Selective fracture jobs without additional downhole equipment are possible.

The majority of implosion applications have been to reduce formation breakdown and injection pressures prior to fracturing or acidizing. A considerable number of field tests have been completed to date with good success. A number of problem formations previously considered incapable of stimulation have been successfully treated after the implosion technique was used.

LEASE PRODUCTION INSTALLATIONS

Significant achievements were made in lease producing installations during 1960. Of particular interest is the widespread increase in use and improvement of automation equipment. Also economical, efficient vapor recovery units are increasing in use; stripper LACT installations have become a reality; the first submersible underwater storage unit was introduced offshore; and many items of producing equipment have been "compacted" for use on marine locations where limited space is available.

Automation. Gulf Oil Corporation has installed what is believed to be the first successful, completely remote controlled (shore-to-platform) offshore production installation in the Gulf of Mexico off the Texas Coast. Three high pressure offshore gas condensate wells are controlled from an onshore station. Automatic instrumentation provides for control functions, measurement of process variables, alarms and monitoring and platform security. All control functions signals and process data are transmitted over a single pair of wires through a submarine electric cable between the platform and the onshore station.

Control functions include open or shut-in well, flow rate regulation, temperature control of the production unit and chemical pump operation. Each well also can

be monitored for nine measured process variables (pressures, temperatures, orifice meter data, etc.). In addition, seven alarms and monitoring functions are provided.

A detailed technical article of this unique producing installation will be published in a future issue of WORLD OIL.

Continental Oil Company now is installing a complete automation, automatic custody transfer and data processing system in the Sacatosa field of Southwest Texas. The installation is unique in that it has been possible to plan the system on the basis of field development. This has proven advantageous since the operator has not been forced to adopt existing installations to the system.

Automation of producing facilities and the handling of collected data are divided into the following categories:

1. Control and scheduling of oil production
2. Periodic testing of levels in vessels
3. Supervision of levels in vessels
4. Measurement of oil produced and witnessing of its transfer from lease to pipe line
5. Automatic use and storage of production data
6. Remote operation and transmission of controls and data.

All wells are connected into automatic test systems which record test oil, water and gas production. The recording system presents well information on punch tape for automatic handling of data. All vessels have high level controls which are tied into necessary alarms and shut-in devices.

When the field has been fully developed and the system completed, it is anticipated that the system will be tied directly into the company's proposed electronic data processing system. This, of course, will provide instant availability of field data whenever required for engineering studies, conservation work, etc.

Sinclair Oil and Gas Company has found that low cost LACT equipment installed on stripper leases will save more money in over-all operations than similar installations on high productivity leases. Prefabricated, skid mounted, LACT units, complete with fail-safe features and using positive displacement meters, have been designed and installed on small leases (30-700 bopd) with success (Figure 5).

These relatively low cost units require a minimum of field connection expense and maintenance. Application of PD meters to this type unit results in an economical and accurate means of determining crude oil delivery.

It is felt that the greatest opportunity for automation in crude production lies in its adaptation to small leases. This requires that the units be rugged, accurate, capable of long unattended operation with a minimum of maintenance and fit into the over-all economics of production costs. Experience has shown that positive displacement meters are well-suited for this type service.

Vapor recovery. Consolidation of tank batteries for LACT installations, unitization and centralization of producing facilities for cost-cutting purposes has made available large volumes of rich stock tank hydrocarbon vapors at central locations. Many operators now are installing small skid mounted compressor units to recover these vapors and inject them into gas plant gathering systems, thus converting a total loss into an attractive source of revenue.

Several types of compressors are in use including liquid seal rotary, small high speed reciprocating (600 rpm +), small positive displacement rotary and the larger conventional slow speed reciprocating type. Most units are powered by electric motors—direct connected in the case of rotary units and V-belt driven on reciprocating units. Since each installation must be designed on its own merits, no one type unit is considered applicable to all installations. Figure 6 shows a typical vapor recovery installation.

Vapor recovery units have proven particularly attractive in West Texas and there is no reason to believe that they will not prove applicable in other producing regions.

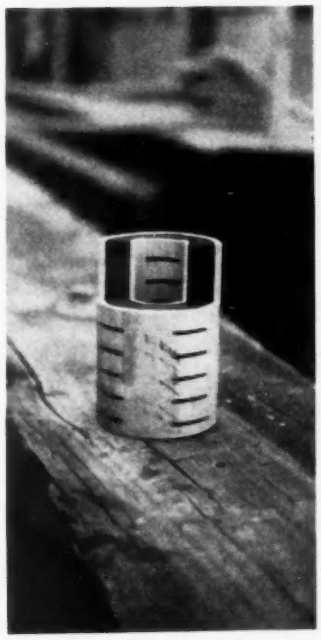


FIGURE 10—New screen to control sand has annular space packed with plastic coated walnut shells to prevent sand intrusion.

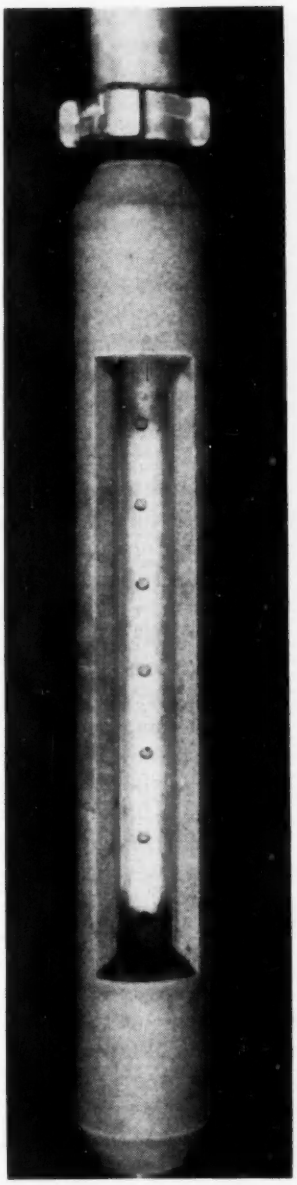


FIGURE 11—Other new type sand screen uses cylinder of sand bonded with thermo-setting resin as the screening medium.

Underwater storage. The California Company now is operating the first self-contained underwater oil storage unit installed in the Gulf of Mexico (Figure 7). The 20,000-barrel capacity unit was sunk in Gulf waters adjacent to a well platform, and is serving as the main production facility in the area.

Advantages of the unit include:

- Marine construction equipment is not required for installation
- Unit is designed to withstand severe weather condi-

tions and is as permanent on location as any other offshore structure

- The filling and discharge operation requires no special training of field personnel, nor are mechanical devices required to prevent salt water contamination of oil or spillage of oil through the sea water displacement system
- Basic sediment, sand and other solids can be removed without raising the unit from its submerged position
- Preventive maintenance is performed easily from above water

From experience with the initial unit, it is anticipated that the same basic design and principals employed can be used to construct a unit capable of storing one million barrels or more in water depths in excess of 200 feet.

"Compacted" producing equipment. Many operators have been forced to reduce the size of producing equipment used on marine locations because of the high cost of platform space. As a result, several unique production units have been developed for this type service.

"Stacked" separation units now have become widely used. Figure 8 shows 15 spherical separators complete with automation equipment installed in a minimum of platform space. By stacking the separators three-deep, the operator was able to install the required number of production units in a space which would have been inadequate had conventional vessels been used.

A four compartmented, 10 foot by 32 foot, vertical heater treater has recently been installed in the marsh area of South Louisiana. The vessel is divided into four separate compartments and can serve four leases without commingling production, thus satisfying conservation regulations (Figure 9).

The unit can handle production equivalent to four 6-foot-by-20-foot heater treaters and has a recommended throughput of 1,200-1,400 bfpd per compartment.

Additional space saving equipment developed for offshore use includes vertical indirect heaters and vertical salt bath heaters. Both types were installed in 1960 and have performed satisfactorily.

Several types of self-contained gas production units now are in common use. Heater and separator are constructed in a single package and are mounted together on a common skid. These type units also are well suited to land operations.

ARTIFICIAL LIFT

Hydraulic pumping. New power packages for hydraulic pumping wells have proven economically attractive in many areas. Basically, two wells are served by a single power source. The energy from the falling rods of one well (down stroke) is used to assist in lifting the rod string of the second well. Advantages of the installation are:

1. Capital investment is reduced since a single power source serves two wells
2. Power requirements and costs are reduced
3. Existing units can be converted to the new system
4. Less maintenance is required.

WORKOVER OPERATIONS

Sand control. Two new sand control screens were proved operational in 1960. One tool consists of concentric slotted metal screens with a permeable filler in the annular space. The exterior screen is aluminum while the inside section is constructed of aluminum or steel, as desired. The annular space between the screens is filled with a permeable network of plastic coated walnut shells (Figure 10), which provides adequate fluid passage but prevents sand intrusion.

Another new type sand control tool consists of a cylinder of 20-40 mesh, round Ottawa sand bonded together and held in place around slotted pipe by a thermo-setting resin (Figure 11). The sand face serves as a direct screening medium. Removal of a portion of the sand cylinder will not destroy screening effectiveness if openings on the pipe are not uncovered.

Hydraulic workover units. Tripping pipe under pressure has been made a safer, more efficient operation by introduction of hydraulic workover units. The units are especially applicable to the concentric tubing workover technique which has become more widely used in the past few years. Units also can be used for workovers on low pressure wells which might be damaged if killed with mud or water.

Units are available at working pressures to 10,000 psi, and some will handle up to 10,000 feet of 2⅞-inch O.D. EUE pipe.

Magnetic actuated wireline tools. Permanent magnets have been used in the construction of a new type downhole landing nipple. Each nipple is provided with two permanent ceramic magnet rings and four steel spacer rings. Nipples with different position numbers can be obtained by varying the spacing between magnets.

In operation, a magnetic selector tool is pinned to a locking tool which is made up on top of the desired production tool (blanking plug, storm choke, etc.). The same type locking tool is used in all nipples and only the selector tool code is changed when operating in different position nipples.

The entire assembly is run in the hole. When the selector tool reaches the appropriately coded landing nipple, sensing elements in the slector respond to the coded magnetic fields in the nipple. Energy then is released electrically from a pressure developing explosive. This pressure actuates the locking assembly which is seated firmly in the nipple.

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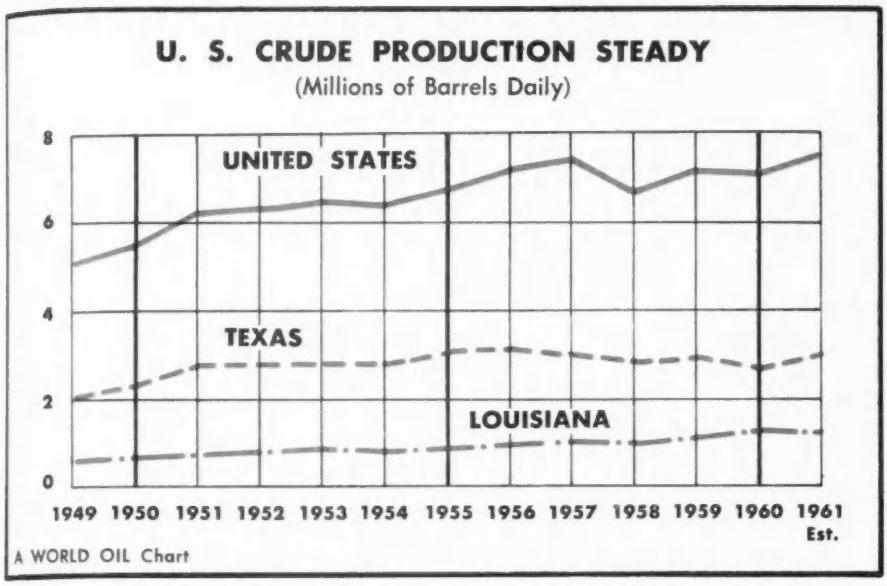


U.S. crude production to set new record in 1961

PRODUCTION OF CRUDE OIL in the United States is expected to increase in 1961 to a new all time peak of 7,210,000 barrels daily. That would be 188,000 bpd or 2.7 percent more than the 7,022,000 daily in 1960. It would be 40,000 bpd more than the previous peak of 7,170,000 in 1957.

The forecast for 1961 is that of the U.S. Bureau of mines. It indicates the need for domestic crude in supplying petroleum demand as estimated by the bureau.

Output was down sharply in 1958 because of recession, recovered sharply in 1959, but had another moderate let-down in 1960, instead of setting a new record as expected. The production of 7,022,000 bpd in 1960 was a decrease of 32,000 bpd or 0.5 percent from the 7,054,000 of 1959.

The cut in production in 1960 was carried out intentionally, through strict allowables, in order to reduce surplus stocks of crude and products. To meet demand for oils, new supply was supplemented by withdrawing 62,000 bpd of crude and 60,000 bpd of products from storage. Those withdrawals reduced the amount of crude production needed.

In 1961 the domestic producer will have a better market for crude mainly because of increased demand for oils but also because less of the demand will be supplied by withdrawals from storage and by imports. It is anticipated that crude stocks will be left about unchanged, though refined products may be supplied from storage in the amount of 71,000 bpd or at about the same rate as in 1960. Total imports are estimated at 1,806,000 bpd in 1961, down 10,000 bpd or 0.6 percent from 1960.

Natural gas liquids are expected to supply 967,000 bpd of the demand for oils in 1961, an increase of 36,000 bpd or 3.9 percent over 1960. That would be 9.6 percent of expected total demand of 10,054,000 bpd. Domestic crude production of 7.2 million bpd would be 71.6 percent of demand.

U.S. Crude Oil Production, by States and Districts, 1960 and 1959
Sources: U.S. Bureau of Mines, except last two months of 1960 from API and all Texas districts from API.

STATE and DISTRICT	BARRELS DAILY 1960	BARRELS DAILY 1959	% Diff.	THOUSAND BARRELS 1960	THOUSAND BARRELS 1959
Alabama	19,981	13,751	+ 1.5	7,313	5,019
Arkansas	78,196	72,134	+ 8.4	28,620	26,329
California	832,050	841,992	— 1.2	304,535	307,327
Colorado	129,017	126,438	+ 2.0	47,221	46,150
Florida	1,005	1,162	— 13.5	368	424
Illinois	217,109	214,890	+ 1.0	79,463	78,435
Indiana	31,833	32,885	— 3.2	11,651	12,003
Kansas	307,457	327,436	— 6.1	112,531	119,514
Kentucky	58,174	72,173	— 19.4	21,292	26,343
Louisiana	1,072,968	971,537	+ 10.4	392,712	354,611
North Louisiana	123,717	124,888	— 0.9	45,281	45,584
South Louisiana	949,251	846,649	+ 12.1	347,431	309,027
Michigan	42,073	28,597	+ 47.1	15,399	10,438
Mississippi	142,249	131,310	+ 8.3	52,064	47,928
Mo.-So. Dak.-Tenn.	926	342	+170.8	339	125
Montana	82,335	82,408	— 0.1	30,135	30,079
Nebraska	66,502	64,847	+ 2.6	24,340	23,669
Nev.-Wash.-Alaska-Ariz.	1,339	696	+ 92.4	490	254
New Mexico	296,124	289,567	+ 2.3	108,383	105,692
Southeast New Mexico	252,491	248,644	+ 1.5	92,413	90,755
Northwest New Mexico	43,633	40,923	+ 6.6	15,970	14,937
New York	4,907	5,427	— 9.6	1,796	1,981
North Dakota	60,136	49,205	+ 22.2	22,010	17,960
Ohio	13,349	15,249	— 12.5	4,886	5,566
Oklahoma	523,361	538,321	— 2.8	191,553	196,487
Pennsylvania	16,975	16,866	+ 0.6	6,213	6,156
Texas	2,547,287	2,695,452	— 5.5	932,321	983,840
Dist. 1: South Central	44,573	45,425	— 1.9	16,314	16,580
Dist. 2: Middle Gulf	112,198	117,885	— 4.8	41,065	43,028
Dist. 3: Upper Gulf	353,364	379,795	— 7.0	129,333	138,625
Dist. 4: Lower Gulf	187,634	190,608	— 1.6	68,675	69,572
Dist. 5: East Central	26,888	29,367	— 8.5	9,841	10,719
Dist. 6: Northeast	244,988	262,441	— 6.7	89,667	95,791
Dist. 7-B: North Central	127,580	135,460	— 5.8	46,695	49,443
Dist. 7-C: West Central	120,935	128,047	— 5.6	44,263	46,737
Dist. 8: West	1,008,756	1,055,101	— 4.4	369,210	385,112
Dist. 9: North	195,880	206,564	— 5.2	71,693	75,396
Dist. 10: Panhandle	106,725	107,819	— 1.0	39,062	39,354
Utah	102,531	109,888	— 6.7	37,527	40,109
Virginia	14	16	— 12.5	5	6
West Virginia	6,300	5,964	+ 5.6	2,306	2,177
Wyoming	367,320	345,118	+ 6.4	134,441	125,968
Total, United States	7,021,623	7,053,671	— 0.5	2,569,914	2,574,590

U.S. Crude Oil Production
Source: U.S. Bureau of Mines, except Nov. and Dec., 1960, from American Petroleum Institute.
(THOUSANDS OF BARRELS)

Year	Total	Daily	Year	Total	Daily
.....	.....	....	1941..	1,402,228	3,842
.....	.....	....	1942..	1,386,645	3,799
1918...	355,928	975	1943..	1,505,613	4,125
1919...	378,367	1,037	1944..	1,677,904	4,584
1920...	442,929	1,213	1945..	1,713,655	4,695
1921...	472,183	1,294	1946..	1,733,939	4,750
1922...	557,531	1,528	1947..	1,856,987	5,088
1923...	732,407	2,007	1948..	2,020,185	5,520
1924...	713,940	1,956	1949..	1,841,940	5,046
1925...	763,743	2,092	1950..	1,973,574	5,407
1926...	770,874	2,112	1951..	2,247,711	6,158
1927...	901,129	2,469	1952..	2,289,836	6,256
1928...	901,474	2,469	1953..	2,357,082	6,458
1929...	1,007,323	2,760	1954..	2,314,988	6,342
1930...	898,011	2,460	1955..	2,484,428	6,807
1931...	851,081	2,332	1956..	2,617,283	7,151
1932...	785,159	2,151	1957..	2,616,901	7,170
1933...	905,656	2,481	1958..	2,448,987	6,710
1934...	908,065	2,488	1959..	2,574,590	7,054
1935...	996,596	2,730	1960..	2,569,914	7,022
1936...	1,099,687	3,013	1961		
1937...	1,279,160	3,505	Est.	2,631,650	7,210
1938...	1,214,355	3,327			
1939...	1,264,962	3,466			
1940...	1,353,214	3,707			

Slight decrease in artificial lift is forecast

A TOTAL of 23,141 wells are expected to be placed on some type of artificial lift during 1961. Expenditures for equipment required to maintain these wells and those already producing by pump or gas lift will increase to $92,232,000.

In a reversal of the post-war trend, fewer wells were equipped with artificial lift the past year than in the previous year. Specifically, 248 fewer wells were placed on lift in 1960 than in 1959. This same trend is in sight for 1961 when it is estimated that 523 fewer wells will be equipped for lift than in 1960. However, slightly increased equipment costs will boost expenditures approximately $3,721,000 this year over 1960.

At the end of 1960, there were 532,710 wells on artificial lift, 11,791 more than a year ago.

Forecast by states. Texas again will place more wells on lift in 1961 than any other state. WORLD OIL predicts the total will be 9,150 wells, 369 less than a year ago. As would be expected, the state also will lead in maintenance equipment expenditures with a total of $31,683,000—an increase of $1,311,000 over 1960.

Kansas displaced Oklahoma as the state placing the second largest number of wells on lift in 1960—2,241 compared to 2,127. However, Oklahoma is expected to regain its second ranking in 1961 with 2,247 compared to Kansas' 2,077. Maintenance expenditures for 1961 for Oklahoma and Kansas will be $11,422,000 and $6,623,000, respectively.

Following the previously mentioned states for 1961 are Kentucky with 1,492 wells, California with 1,037 wells and Louisiana with 1,025 wells.

In terms of maintenance expenditures only, California will invest the second largest sum after Texas in 1961, a total of $17,125,000, or slightly over $1 million more than last year.

Estimates of 1961 Artificial Lifting Equipment

(Includes requirements for all types of pumping, hydraulic power, and gas lift units)

STATE or DISTRICT	Est. Wells to go on Artificial Lift in 1961	Wells Put on Pump or Lift in 1960	New Oil Wells Completed in 1960	No. Flowing Oil Wells End of 1960	Oil Wells on Artificial Lift End of 1960	Net Wells Shut in or Abandoned in 1960	Est. Maintenance Cost For All Art. Lift Wells in 1961 (Equipment only)
Alabama	**66**	**70**	**41**	**0**	**380**	**—66‡**	**47,000**
Arkansas	**298**	**277**	**282**	**183**	**5,810**	**348**	**834,000**
California	**1,037**	**1,035**	**1,116**	**1,196**	**36,388**	**748**	**17,125,000**
***Colorado**	**384**	**378**	**123**	**127**	**1,892**	**187**	**369,000**
Illinois	**827**	**835**	**774**	**67**	**38,239**	**1,332**	**4,754,000**
Indiana	**395**	**392**	**309**	**86**	**5,381**	**314**	**630,000**
Kansas	**2,077**	**2,241**	**2,265**	**312**	**46,270**	**—4,153‡**	**6,623,000**
Kentucky	**1,492**	**1,574**	**1,568**	**13**	**20,733**	**1,978**	**2,642,000**
Louisiana	**1,025**	**1,081**	**1,620**	**8,896**	**14,389**	**755**	**3,084,000**
*North Louisiana	654	651	620	729	11,234	476	1,711,000
South Louisiana	371	430	1,000	8,167	3,155	279	1,373,000
***Michigan**	**350**	**368**	**368**	**850**	**3,704**	**84**	**601,000**
Mississippi	**432**	**414**	**308**	**277**	**2,347**	**303**	**572,000**
***Montana**	**415**	**417**	**119**	**33**	**3,478**	**314**	**652,000**
Nebraska	**300**	**287**	**281**	**15**	**1,627**	**133**	**352,000**
***New Mexico**	**352**	**383**	**1,005**	**5,323**	**7,261**	**453**	**2,291,000**
New York	**209**	**180**	**180**	.....	**19,000**	**455**	**1,204,000**
North Dakota	**421**	**472**	**154**	**74**	**1,343**	**117**	**197,000**
Ohio	**432**	**474**	**464**	**150**	**14,560**	**682**	**1,034,000**
Oklahoma	**2,247**	**2,127**	**2,287**	**3,147**	**80,459**	**—204‡**	**11,422,000**
***Pennsylvania**	**303**	**271**	**281**	**10**	**65,000**	**2,851**	**3,844,000**
Texas	**9,150**	**9,519**	**7,875**	**45,722**	**143,789**	**4,028**	**31,683,000**
Dist. 1: South Central	388	497	561	416	8,031	35	1,456,000
Dist. 2: Middle Gulf	89	97	163	3,320	2,456	3	510,000
Dist. 3: Upper Gulf	581	624	476	4,419	8,325	486	1,525,000
Dist. 4: Lower Gulf-S.W.	448	421	292	4,652	6,956	476	1,415,000
Dist. 5: E. Central	12	17	25	327	2,814	—48‡	719,000
Dist. 6: N.E.	662	657	531	11,397	12,929	342	3,381,000
Dist. 7-B: N. Cent.	1,108	1,121	1,031	2,220	14,141	802	3,277,000
Dist. 7-C: W. Cent.	678	708	440	2,363	5,429	519	1,246,000
Dist. 8: West	3,015	3,069	2,231	14,767	38,922	471	8,733,000
Dist. 9: North	1,647	1,750	1,545	1,476	31,333	860	7,171,000
Dist. 10: Panhandle	522	558	580	365	12,453	82	2,250,000
Utah	**91**	**93**	**99**	**352**	**404**	**6**	**63,000**
West Virginia	**261**	**218**	**218**	.....	**12,950**	**153**	**876,000**
Wyoming	**545**	**539**	**463**	**413**	**7,117**	**51**	**1,308,000**
†**Other States**	**32**	**19**	**33**	**21**	**189**	**—13‡**	**25,000**
Total United States	**23,141**	**23,664**	**22,233**	**67,267**	**532,710**	**10,856**	**92,232,000**

*** 1959 data revised. † Alaska, Arizona, Florida, Missouri, Nevada, South Dakota, Tennessee, Virginia, and Washington. ‡ Net wells put back on production. Kansas figures reflect increase in wells opened on small waterflood projects.**

U.S. Wells Producing Crude Oil at End of 1960, by States

Figures do not include inactive or shut in wells, gas wells, or gas-condensate wells. Data compiled by WORLD OIL, with cooperation of state conservation departments and other sources.

STATE or DISTRICT	Crude Oil Wells			Bbls. Daily Production	
	Flowing	Artificial Lift	Total Wells	Total	Per Well
Alabama		380	380	21,400	56.3
Alaska	18		18	3,200	177.8
Arizona	2	1	3	250	83.3
Arkansas	183	5,810	5,993	74,450	12.4
California	1,196	36,388	37,584	837,400	22.0
Colorado	127	1,892	2,019	133,000	65.9
Florida		11	11	900	81.8
Illinois	67	38,239	38,306	220,250	5.7
Indiana	86	5,381	5,467	32,850	6.0
Kansas	312	46,270	46,582	298,100	6.4
Kentucky	13	20,733	20,746	54,000	2.6
Louisiana	8,896	14,389	23,285	968,300	41.6
North Louisiana	729	11,234	11,963	105,300	8.8
South Louisiana	8,167	3,155	11,322	863,000	76.2
Michigan	850	3,704	4,554	50,000	11.0
Mississippi	277	2,347	2,624	147,500	56.2
Missouri		121	121	100	0.8
Montana	33	3,478	3,511	79,400	22.6
Nebraska	15	1,627	1,642	64,850	39.5
Nevada		2	2	100	50.0
New Mexico	5,323	7,261	12,584	289,700	23.0
Northwest N. M.	471	936	1,407	34,700	24.7
Southeast N. M.	4,852	6,325	11,177	255,000	22.8
New York		19,000	19,000	4,250	0.2
North Dakota	74	1,343	1,417	69,500	49.0
Ohio	150	14,560	14,710	9,350	0.6
Oklahoma	3,147	80,459	83,606	548,000	6.6
Pennsylvania	10	65,000	65,010	14,000	0.2
South Dakota		19	19	450	23.7
Tennessee		27	27	50	1.8
Texas	45,722	143,789	189,511	2,500,000	13.2
Dist. 1: S. Central	416	8,031	8,447	44,000	5.2
Dist. 2: Middle Gulf	3,320	2,456	5,776	108,000	18.7
Dist. 3: Upper Gulf	4,419	8,325	12,744	320,000	25.1
Dist. 4: L. Gulf-S.W.	4,652	6,956	11,608	179,000	15.4
Dist. 5: East Central	327	2,814	3,141	27,000	8.6
Dist. 6: Northeast	1,934	3,648	5,582	109,000	19.5
Dist. 6: E. Texas Field	9,463	9,281	18,744	133,000	7.1
Dist. 7-B: N. Central	2,220	14,141	16,361	123,000	7.5
Dist. 7-C: W. Central	2,363	5,429	7,792	117,000	15.0
Dist. 8: West	14,767	38,922	53,689	1,041,000	19.4
Dist. 9: North	1,476	31,333	32,809	199,000	6.1
Dist. 10: Panhandle	365	12,453	12,818	100,000	7.8
Utah	352	404	756	110,900	146.7
Virginia		8	8	10	1.2
Washington	1		1		
West Virginia		12,950	12,950	4,650	0.4
Wyoming	413	7,117	7,530	379,300	50.4
Total U.S., End of 1960	**67,267**	**532,710**	**599,977**	**6,916,210**	**11.5**
Total U.S., End of 1959	68,614	520,919	589,533	6,890,180	11.7

Number of producing oil wells at new high

THERE WERE 599,977 PRODUCING OIL WELLS in the United States at the end of 1960, a new record, although crude oil production in 1960 was below some previous peaks.

During 1960 the average number of wells on production was 594,755, as the number rose to the 599,977 on December 31 from 589,533 on January 1. Since U. S. crude production averaged 7,022,000 barrels per day in 1960, the output per well averaged 11.8 barrels daily. That was as low as in 1958 and 1950 and lower than in other post war years except the 11.4 bpd of 1949 and 11.3 of 1946 and 1945.

The net increase in producing oil wells in 1960 was 10,444, or 4,574 less than the gain of 15,018 in 1959. The net addition in 1960 was held down by a decrease in the number of new oil wells being completed and some increase in abandonments of old wells. The 22,233 new oil well completions of 1960 were 3,299 fewer than the 25,532 of 1959. Indicated abandonments of 11,789 in 1960 were 1,275 more than the 10,514 of 1959.

The 599,977 oil wells on production at the close of December 1960 were then producing 6,916,200 barrels daily, an average of 11.5 bpd per well. The 589,533 producing at the end of December 1959 yielded 6,890,180 bpd total, or 11.7 bpd per well.

U. S. Producing Oil Wells and Daily Output Per Well, by Years

Sources: Producing wells and output from Bureau of Mines except as noted. Wells completed from WORLD OIL and predecessor, The Oil Weekly, except 1918-1920 from Bureau of Mines. Output per well obtained by dividing daily average U. S. production for year by average number between wells producing Jan. 1 and Dec. 31.

YEAR	Wells Producing at Year End	Changes During Year: Wells Completed	Changes During Year: *Wells Abandoned	Changes During Year: †Net Gain in Wells	Bbls. Prod. per Well per Day
1918	203,375	17,860	.....	.....	....
1919	227,000	21,041	—2,584	23,625	4.8
1920	251,000	24,278	278	24,000	5.0
1921	274,500	14,715	—8,785	23,500	4.9
1922	284,880	17,790	7,410	10,380	5.7
1923	290,100	16,182	10,962	5,220	6.6
1924	299,100	14,707	5,707	9,000	6.2
1925	306,100	17,029	10,029	7,000	6.5
1926	318,600	18,626	6,126	12,500	6.8
1927	323,300	14,382	9,682	4,700	7.7
1928	327,800	12,348	7,848	4,500	7.6
1929	328,200	15,362	14,962	400	8.4
1930	331,070	11,693	8,823	2,870	7.5
1931	315,850	7,011	22,231	—15,220	7.2
1932	321,500	10,530	4,880	5,650	6.7
1933	326,850	8,070	2,720	5,350	7.7
1934	333,070	13,119	6,899	6,220	7.5
1935	340,990	15,418	7,498	7,920	8.1
1936	349,450	18,704	10,244	8,460	8.7
1937	363,030	23,115	9,535	13,580	9.8
1938	369,640	19,106	12,496	6,610	9.1
1939	380,390	17,734	6,984	10,750	9.2
1940	389,010	19,843	11,223	8,620	9.6
1941	399,960	19,590	8,640	10,950	9.7
1942	404,840	10,977	6,097	4,880	9.4
1943	407,170	9,887	7,557	2,330	10.2
1944	412,220	13,502	8,452	5,050	11.2
1945	415,750	13,944	10,414	3,530	11.3
1946	421,460	16,087	10,377	5,710	11.3
1947	426,280	17,613	12,793	4,820	12.0
1948	437,880	22,197	10,597	11,600	12.8
1949	448,680	21,415	10,615	10,800	11.4
1950	465,870	23,775	6,585	17,190	11.8
1951	474,990	23,532	14,412	9,120	13.1
1952	488,520	23,371	9,841	13,530	13.0
1953	498,940	25,251	14,831	10,420	13.1
1954	511,200	28,063	15,803	12,260	12.6
1955	524,010	30,474	17,664	12,810	13.2
1956	551,170	30,641	3,481	27,160	13.3
1957	569,273	27,519	9,416	18,103	12.8
1958	574,965	24,048	18,416	5,632	11.7
1958‡	574,515	24,048	13,076	10,972	11.8
1959‡	589,533	25,532	10,514	15,018	12.1
1960‡	599,977	22,233	11,789	10,444	11.8

* Wells abandoned or shut in. Minus sign (—) indicates shut in wells put on production. † Minus sign (—) indicates decrease in producing wells. ‡ WORLD OIL compilation.

Producing gas wells increase sharply

THE NUMBER of producing gas wells in the United States increased sharply during 1960, and at the end of the year stood at a new peak of 94,617. That total was a net increase of 8,361 over the 86,256 gas and gas-condensate wells on production at the end of 1959.

The large net increase occurred as a result of completing 5,129 new gas and gas-condensate wells during the year and putting into production several thousands of shut-in wells.

Well over 3,000 idle wells evidently were activated, as 3,232 such well openings must have occurred even if no old wells were abandoned. Actually, even more doubtless were taken out of shut-in status, as some opening of idle wells only compensated for abandonments of old wells. In recent years around 1,500 old wells per year have been abandoned.

The continuing expansion in the number of producing gas wells reflects vigorous growth in gas consumption, as more pipe lines are completed, and strong demand for all available supplies of gas.

In response to the good market for gas and continuing gradual improvement in prices of gas at the wells, operators have been putting emphasis on development of gas production. The 5,129 gas and gas-condensate well completions in 1960 represented an increase of 259 wells over the 4,870 completed in 1959. That increase occurred in the face of a relatively sharp curtailment of oil well completions. Meanwhile, operators also are putting shut-in wells into production as markets open up and prices improve.

In 1960, noteworthy increases in gas producing wells occurred especially in Texas and Louisiana.

U.S. Producing Gas Wells and Daily Output Per Well, by Years

(Including gas-condensate wells)

Sources: Bureau of Mines except as noted. Output per well obtained by dividing daily average gross production from gas wells for year by average number between wells producing Jan. 1 and Dec. 31.

YEAR	Wells Producing at Year End	Changes During Year: [1]Wells Completed	[2]Wells Abandoned	[3]Net Gain in Wells	[4]Mcf. Prod. Per Well Per Day
1929	[5]53,545	3,107	[6]	[6]	[6]
1930	[5]55,020	2,971	1,496	1,475	[6]
1931	[5]55,756	2,067	1,331	736	[6]
1932	[5]54,156	1,079	2,679	—1,600	[6]
1933	[5]53,660	1,190	1,686	—496	[6]
1934	54,130	1,496	1,026	470	[6]
1935	53,790	1,802	2,142	—340	[6]
1936	54,500	2,375	1,665	710	75
1937	55,050	2,732	2,182	550	81
1938	53,770	2,143	3,423	—1,280	79
1939	55,530	2,030	270	1,760	92
1940	53,880	2,265	3,915	—1,650	105
1941	55,500	3,279	1,659	1,620	125
1942	56,150	2,790	2,140	650	142
1943	57,200	2,390	1,340	1,050	155
1944	58,780	3,078	1,498	1,580	172
1945	60,600	3,192	1,372	1,820	178
1946	62,740	3,562	1,422	2,140	169
1947	63,676	3,720	2,784	936	163
1948	64,212	3,312	2,776	536	196
1949	63,346	3,499	4,365	—866	214
1950	64,900	3,480	1,926	1,554	239
1951	65,100	3,542	3,342	200	273
1952	65,450	3,693	3,343	350	286
1953	68,223	3,806	1,033	2,773	291
1954	70,192	4,219	2,250	1,969	291
1955	71,475	4,169	2,886	1,283	303
1956	74,261	4,495	1,709	2,786	311
1957	77,041	4,622	1,842	2,780	316
1958	80,400	5,042	1,683	3,359	319
1959[1]	83,328	5,042	583	4,459	309
1960[1]	86,256	4,870	1,942	2,928	307
	94,617	5,129	—3,232	8,361	[6]

[1] WORLD OIL data. [2] Wells abandoned or shut in. Minus sign (—) indicates shut in wells put on production. [3] Minus sign (—) indicates decrease in producing wells. [4] Thousand cubic feet from gas wells; excludes gas from oil wells. [5] Average during year. [6] Not available.

U. S. Wells Producing Gas and Gas-Condensate at End of 1960, by States

Figures do not include any wells shut in or any wells producing crude oil. Gas-condensate wells shown are wells producing condensate for handling on leases and in pipe lines along with crude oil and not in plants.

STATE or DISTRICT	Gas Wells	Gas-Condensate Wells: Wells	Bbls. Daily Production: Total	Bbls. Daily Production: Per Well	Total Gas-Cond. & Gas Wells
Arkansas	406	42	100	2.4	448
California	678	*	.....	.....	678
Colorado	454	.....	.....	.....	454
Illinois	55	.....	.....	.....	55
Indiana	363	.....	.....	.....	363
Kansas	6,294	.....	.....	.....	6,294
Kentucky	4,350	.....	.....	.....	4,350
Louisiana	3,677	2,801	143,500	51.2	6,478
North Louisiana	2,603	1,005	5,500	5.5	3,608
South Louisiana	1,074	1,796	138,000	76.8	2,870
Michigan	194	.....	.....	.....	194
Mississippi	17	352	4,100	11.6	369
Missouri	7	.....	.....	.....	7
Montana	947	.....	.....	.....	947
Nebraska	38	.....	.....	.....	38
New Mexico	5,129	742	8,500	11.5	5,871
Northwest N. M.	4,159	425	.....	.....	4,584
Southeast N. M.	970	317	8,500	26.8	1,287
New York	1,000	5	.....	.....	1,005
North Dakota	28	.....	.....	.....	28
Ohio	6,965	.....	.....	.....	6,965
Oklahoma	5,875	.....	.....	.....	5,875
Pennsylvania	16,500	.....	.....	.....	16,500
Tennessee	30	.....	.....	.....	30
Texas	17,770	6,105	100,000	16.4	23,875
Dist. 1: S. Central	273	113	3,150	27.9	386
Dist. 2: Middle Gulf	2,375	1,019	9,050	8.9	3,394
Dist. 3: Upper Gulf	2,204	1,388	42,950	30.9	3,592
Dist. 4: L. Gulf-S.W.	3,029	957	12,400	13.0	3,986
Dist. 5: East Central	207	130	400	3.1	337
Dist. 6: Northeast	1,890	755	11,000	14.6	2,645
Dist. 7-B: N. Central	612	114	400	3.5	726
Dist. 7-C: W. Central	318	179	3,550	19.8	497
Dist. 8: West	694	406	13,200	32.5	1,100
Dist. 9: North	804	632	1,900	3.0	1,436
Dist. 10: Panhandle	5,364	412	2,000	4.9	5,776
Utah	43	.....	.....	.....	43
West Virginia	13,300	.....	.....	.....	13,300
Wyoming	350	†	500	.....	350
‡Miscellaneous	100	.....	.....	.....	100
Total U.S., 1960	84,570	10,047	256,700	25.5	94,617
Total U.S., 1959	77,006	9,250	211,520	22.9	86,256

*Condensate wells are included in another table with flowing oil wells. †Gas-conden sate wells are included with gas wells. ‡Alabama, Alaska, Arizona, Maryland, Virginia.

12 U.S. areas have new producing depth records

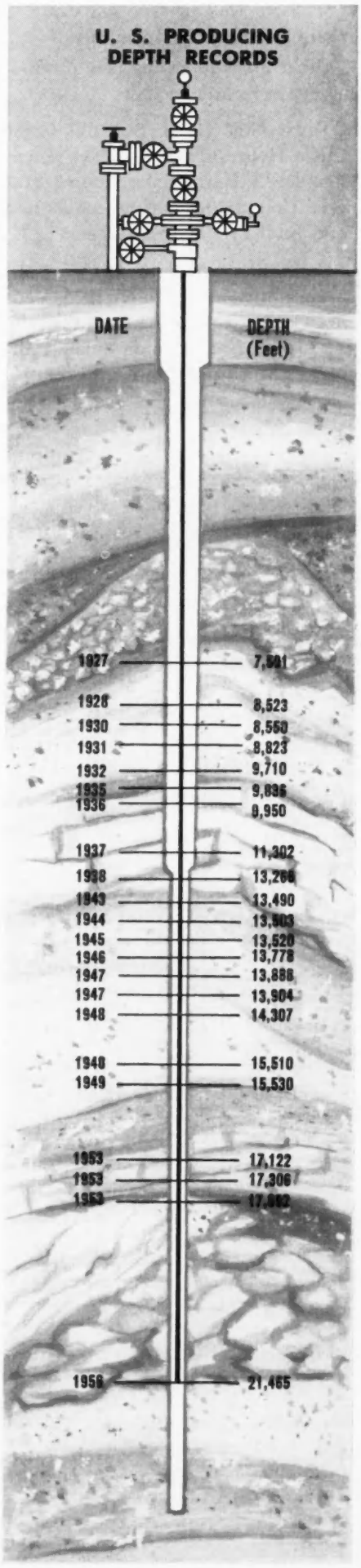
THE WORLD'S deepest producing well, although it still holds the record, no longer is producing from the greatest depth. It has been replaced by a well in the same Lake Washington field in Plaquemines Parish, Louisiana.

The well now producing from the greatest depth is R. F. Price et al No. 1 at 20,186 feet. The other Lake Washington well, Richardson Bass et al's Humble-LL&E 1-L, originally produced from 21,465 feet, later was plugged back to 20,745 feet, was recompleted at 20,502 feet in 1959, then was plugged back again to 19,788 feet last year.

In addition to the above change, 11 U.S. producing areas reported new depth records during 1960. Five of the new record holders are oil wells, five are condensate, and two are gas wells.

West Texas and the North Texas-Panhandle areas entered the 16,000-foot category for the first time last year. The new West Texas titleholder is Atlantic Refining's Kelly 1 gas well, producing from 16,680 feet in Pecos County's Hershey field. The well moved West Texas from the nation's seventh deepest producing area to fourth.

The North Texas-Panhandle area moved from 11th to fifth deepest, with the completion of Standard of Texas' McAdams 1-3 et al Tr. 3



Holders of Record as Deepest Producing Well in U. S., Since 1927

Year Drilled	WELL AND LOCATION	Production	Bottom of Pay (Feet)
1927	E. J. Miley's Athens 6, Rosecrans field, California	....	7,591
1928	Texon Oil & Land Co.'s University 1-B, Big Lake field, West Texas	Oil	8,523
1930	Star Petroleum Co.'s Colby 2, Long Beach, California	....	8,550
1931	Tide Water Associated Oil Co.'s Lloyd 57, Ventura Avenue field, California	Oil	8,823
1932	Tide Water Associated Oil Co.'s Lloyd 83, Ventura Avenue field, California	Oil	9,710
1935	Tide Water Associated Oil Co.'s Lloyd 131, Ventura Avenue field, California	Oil	9,836
1936	The Texas Co.'s Lafitte 5, Lafitte field, South Louisiana	Oil	9,950
1937	Union Oil Co.'s Kernco 85-34, Rio Bravo field, Kern County, California	Oil	11,302
1938	Fohs Oil Co.'s Buckley-Bourg 1, DeLarge field, South Louisiana	*Cond.	13,266
1943	Union Producing Co.-Fohs Oil Co.'s Fitzpatrick-Vizard 1, DeLarge field, South Louisiana	*Cond.	13,490
1944	Union Producing Co.-Fohs Oil Co.'s Buckley-Bourg 2, DeLarge field, South Louisiana	Oil	13,503
1945	Shell Oil Co.'s Smith-State Unit 1-1, Weeks Island field, South Louisiana	Oil	13,520
1946	Shell Oil Co.'s Smith-State Unit 1-2, Weeks Island field, South Louisiana	Oil	13,778
1947	Shell Oil Co.'s Smith-State Unit 1-3, Weeks Island field, South Louisiana	Oil	13,888
1947	The Texas Co.'s LaFourche Basin Levee Dist. 1, Queen Bess Island field, South Louisiana	*Cond.	13,904
1948	Pure Oil Co.'s Unit 1, West Poison Spider field, Wyoming	Oil	14,307
1948	Denver Producing & Refg. Co.'s School Land 1-A, Cogar field, Caddo County, Okla.	Gas	15,510
1949	Standard Oil Co. of California's Mushrush 5, Wasco field, Kern County, California	Oil	15,530
1953	Shell Oil Co.'s Weeks-Gall Unit 1-1, Weeks Island field, South Louisiana	Oil	17,122
1953	Shell Oil Co.'s Gonsoulin Minvielle-State 2, Weeks Island field, South Louisiana	Oil	17,306
1953	Richfield Oil Corp.'s Cole Levee "A" 67-29, Coles Levee, North field, California	Oil	17,892
1956	Richardson & Bass et al's Humble-LL&E 1-L, Lake Washington field, South Louisiana	Oil	21,465

condensate well in Grayson County, from Ordovician at 16,555 feet.

Other areas reporting new producing depth records include:

Texas Gulf Coast. Sun Oil Company's Houston Farms Development Company 1, Rattlesnake Mound, Brazeria County, producing condensate from Basil Frio at 15,995 feet.

California. Standard Oil of California's Burson 1, Fillmore field, Ventura County, producing from Pliocene at 15,343 feet. Standard of California's Mushrush 5 in Kern County's Wasco field was the previous record holder at 15,530 feet, but is no longer producing.

Southwest Texas. Mobil Oil's L. M. Morrison 1 condensate well, Morrison field, Val Verde County, from Ellenburger at 14,940 feet.

East Texas. Pan American Petroleum Corporation's 1 Niendorff, Mary Starr, Yantis County, from Jurassic at 12,890 feet.

North Louisiana. Humble Oil and Refining's Sale-Beene 1 oil well, North Shongaloo—Red Rock field, from Smackover at 11,590 feet.

Arkansas. Austral Oil Company's International Paper Company condensate well, Lafayette County, from Smackover, at 11,028 feet.

Pennsylvania. Felmont Oil, Peoples Natural Gas Robert Snyder gas well 1, Somerset County, from Oriskany at 8,625 feet.

Arizona. Texaco 1 Navajo Z wildcat producing oil from Devonian at 6,793 feet in Apache County.

Missouri. William Grunerwald 1 Curris in Holt County, producing oil from Ordovician at 2,975 feet.

Regional Producing Depth Records in the United States

State or District	Bottom of Pay (Feet)	Year Drilled	Wells and Location	Producing Formation	Production
S. La.-Inshore	**20,186**	1957	R.F. Price 1, State Lease 2145	Miocene	Oil
Oklahoma	**16,912**	1957	British American's Krieger 1, Knox field, Stephens County	Ordovician	Cond.
S. La.-Offshore	**16,840**	1957	Hunt Oil's No. 2 State Lease 758, blk 39, Coon Point field, Ship Shoal area	Miocene	Cond.
West Texas	**16,680**	1960	Atlantic Refining's Kelly 1, Hershey field, Pecos County	Ordovician	Gas
N. Tex. Pan.	**16,555**	1960	Standard of Texas' McAdams 1-3, et al Tr. 3, Grayson County	Ordovician	Cond.
Wyoming	**16,472**	1957	Pure Oil's Badwater Unit 1, wildcat, Natrona County	U. Cretaceous	Gas
Tex. G. Coast	**15,995**	1960	Sun Oil's Hou. Farms Dvlpmt. Co. 1, Rattlesnake Mound, Brazoria Cty.	Basil Fris	Cond.
California	**15,343**	1960	Stand. Oil of Calif, Burson 1, Fillmore field, Ventura Cty.	Pliocene	Oil
Mississippi	**15,256**	1958	Gulf's Well 1-ZB, Soso Unit, tract 28-7, Soso field, Jasper County	Cotton Valley	Oil
N. Mex.-S.E.	**15,025**	1955	Continental's Bell Lake Unit 1-a, Bell Lake field, Lea County	Devonian	Gas
S W. Texas	**14,940**	1960	Mobil Oil's L.M. Morrison 1, Morrison field, Val Verde Cty.	Ellenburger	Cond.
East Texas	**12,890**	1960	Pan American Pet. Corp. No. 1 Niendorff, Mary Starr, Yantis Cty.	Jurassic	Cond.
North Dakota	**12,666**	1958	Amerada's H.H. Shelvik Tract 1 #1, wildcat, McKenzie County	Silurian	Oil
Montana	**12,605**	1953	Sun & Phillip's Dynneson 1, 32-24n-58e, Brorson field, Richland County	Red River	Oil
Utah	**11,895**	1959	Standard of Calif.'s Uintah-Curay 3, wildcat, 5-1n-2w, Duchesne Co.	Wasatch	Oil
Alabama	**11,612**	1958	Zach Brooks Co.-Magnolia's School Ld 1, Citronelle field, Mobile Co.	Rodessa	Oil
N. Louisiana	**11,590**	1960	Humble's Sale-Beene 1, North Shongaloo-Red Rock field	Smackover	Oil
Florida	**11,588**	1948	Humble's Lee Tidewater Cypress Lbr. 1-B, Sunniland fld., abandoned.	L.Cretaceous	Oil
Alaska	**11,543**	1959	Standard of Calif.-Richfield's Swanson River Unit, No. 34-10	Hemlock, Eoc.	Oil
Arkansas	**11,028**	1960	Austral Oil Co., Intl. Paper Co. Lafayette Cty.	Smackover	Cond.
Colorado	**10,267**	1959	California Co.'s Bald Creek 1, wildcat, 17-7s-90w, Garfield County	Mancos	Gas
N. Mex. N.W.	**9,300**	1950	El Paso Natural's Ute 4, Baker Creek field, San Juan County	Paradox	Gas
South Dakota	**8,691**	1954	Shell Oil's State 1-A, Buffalo field, Harding County	Red River	Oil
Pennsylvania	**8,625**	1960	Felmont Oil, Peoples Nat. Gas Robt. Snyder 1, Somerset Cty.	Oriskany	Gas
W. Virginia	**8,410**	1946	Ohio Oil's Kuykendall et al 1, Canaan Valley field, Tucker County	Oriskany	Gas
Michigan	**7,760**	1941	Gulf Refining's Bateson 1, Monitor Twp., Bay County (Abandoned)	Salina	Gas
Nebraska	**7,419**	1956	R.W. McDowell, Jr's State 778-1, McDowell field, Kimball County	Dakota "J"	Oil
Nevada	**7,360**	1955	Shell's Eagle Springs Unit 15-35, Eagle Springs field, Nye County	Tertiary	Oil
Maryland	**7,100**	1953	Snee & Eberly's McCullough Heirs 1, Garrett County	Chert	Gas
Arizona	**6,793**	1960	Texaco 1, Navajo Z, wildcat, Apache County	Devonian	Oil
Kansas	**6,512**	1959	Westhoma Oil Co.'s Long 1, Wide Awake field, 5-35s-34w, Seward Co.	Chester	Oil
Virginia	**6,158**	1954	Clinchfield Coal's Std. Banner Coal 152, Ervington dist., Dickenson Co.	Silurian	Gas
Ohio	**5,790**	1959	Ohio Fuel Gas-East Ohio Gas-Wiser Oil's F. Smith 1-A Hinckley Tp., Medina County	Cambro-Ord.	Gas
Kentucky	**5,373**	1957	United Fuel Gas's Kentland 67, Big Sandy field, Pike County	Devonian	Gas
Illinois	**5,338**	1959	Texaco's H. Silverman 16, Aden Consol. pool, Wayne County	Dutch Creek	Oil
New York	**5,228**	1942	E. Kent Kane's Robert Lewis 1, W. Union Twp., Steuben County	Oriskany	Gas
Washington	**4,135**	1957	Sunshine Mining's J.W. Tanner-Medina 1, Grays Harbor County	Oligocene	Oil
Tennessee	**3,107**	1954	Greenup-David et al's Coal Creek 1, Briceville field, Anderson County	Chattanooga	Gas
Indiana	**3,093**	1953	Hartman & Jordan's Comm. Albert Aldrich & J.C. Ellis 1, Welborn North field, Posey County	McClosky	Oil
Missouri	**2,975**	1959	Wm. Grunerwald 1, Currie, Holt County	Ordovician	Oil

Exploration Outlook 1961

Industry remains vigorous, keys trend plays to markets, scrutinizes prospects and costs closely. Few new-province ventures seen

OPTIMISM TEMPERED BY CAUTION was generally evident throughout the North American continent north of the United States-Mexico border in January 1961. A few radically different plays were on the horizon in such areas as Alaska, the Canadian Arctic Islands, and in offshore areas in the Atlantic coastal states and Oregon. New onshore areas in Georgia and Iowa were receiving new exploratory emphasis. But these new-province plays are very exceptional. There is an unusually strong tendency to follow known trends. This tendency is certain to dominate exploratory drilling in 1961.

The opinions of geologists in all parts of the United States and Canada have been solicited by WORLD OIL, and the replies generally lack so high a degree of optimism evident in the last year's survey (WORLD OIL, February 1, 1960, pp. 155-189). Activity has quickened in the Sacramento Valley gas search, and this California play may become even more intense as good gas reserves continue to be found at shallow and moderate depths. More recently some minor oil production, the first in the Sacramento Valley, was found accidentally when a gas well went to oil. In the Paradox Basin, large oil and gas reserves continue to be proved, and this play, though a costly one, should hold steady or accelerate this year.

Reports from east and north Texas, and from Mississippi, Oklahoma, and the Williston Basin are rather optimistic this year.

A significant shallow oil discovery has been made in Menard County, Texas, in an area heretofore thought to be too high on the Llano Uplift to offer hope of very profitable reserves. Strong activity should continue in Kansas, Nebraska and Colorado on Las Animas and Cambridge arches (WORLD OIL, August 1, 1960, pp. 78-83 and September 1960, pp. 87-92). The finding of some lower Paleozoic oil in Iowa is another case of new emphasis on shallow areas near major regional uplifts, in this case areas south of the Wisconsin Arch.

Another surprise is a recent gas discovery in both Oriskany and Medina sandstones in Delaware County,

New York, in the western Catskills region south of the Adirondack Uplift. This is a renewal of an older play (World Oil, February 1, 1956, pp. 40-42).

Although little in the way of new reserves has been found pursuant to the search for another Greensburg field in central Kentucky, the resulting emphasis on shallow prospects near major uplifts is getting results in some similar areas which may provide some surprises in 1961 as in 1960.

The expected strong activity increase offshore from California failed to materialize last year despite the vast oil reserves that seem sure to be present there. High, sliding-scale state royalties, and high lease bonuses aggravate the normally greater costs of operating offshore, pushing outlays perhaps to the point of diminishing returns. An offshore lease sale in Texas in December aroused little interest, and major companies generally offered rather nominal bonuses. Offshore from Louisiana, however, rigs were generally busy as 1961 began, and development is expected to be maintained at a fairly vigorous pace there.

Exploration is being geared to a more orderly expansion, in accordance with market conditions. The more heavily gas-bearing trends, particularly in Louisiana, Texas, California, Oklahoma and British Columbia are enjoying vigorous exploratory drilling since gas is in stronger market demand position than crude oil. High operating costs, unsatisfactory prevailing prices for crude, rate-case handling slowdowns on interstate-bound gas in the United States, and current uncertainty as to crude oil imports and prospective tax legislation are slowing exploratory activity. The time is ripe for effective new methods to find stratigraphic traps and thus to provide more attractive prospects to drill.

U.S. GULF COAST

South Texas (Railroad Commission districts 1, 2, and 4). The most interesting areas involving Wilcox and younger sediments are those of successful recent deep drilling.

The lower Wilcox enjoyed a high success ratio for wells drilled in 1960. Multi-zone completions increase the attractiveness of this trend. In Zapata County, gathering systems have been, or will be extended to offer a market for currently shut-in gas wells.

The Northeast Thompsonville field in Jim Hogg County is a significant recent discovery. This field *has much better porosity and permeability* than is generally encountered in the southern portion of the lower Wilcox trend.

About eight miles southwest of Northeast Thompsonville field, a very interesting new discovery was being completed in January; Gulf Oil Corp. Hector Vela 1 tested gas thru perforations 13,960-82 feet. Casing is set at 14,000 feet.

Zapata, Jim Hogg, Webb, and Duval counties will receive much attention for lower Wilcox prospects in 1961. In the northeast portion of this trend, De Witt County enjoyed an active, successful year in 1960 with several oil and gas-condensate completions in multiple zones. Operators will try to extend this portion of the trend into adjoining counties.

The deep Vicksburg trend is active along the Starr-Hidalgo county line. Shell Oil Co. Wood Christian 1 tested 5,600 Mcfpd thru perforations 10,581-610 feet. On a ¼-inch choke, flowing tubing pressure was 5,000 psi; condensate yield was 36 barrels per million.

The lower Frio continues to be strongly sought after in South Texas. A recent gas condensate find is the Cosden Petroleum Corp. T. A. McKamey 1, three miles west of Gregory, San Patricio County. This well was completed through perforations 9,460-87 feet for 4,000 Mcfpd open flow, with shut-in tubing pressure 3,042 psi, and 54 barrels of 59.5° API gravity condensate per million; and through perforations 9,977-92 feet, for 11 MMcfpd open flow, SITP 3,746 psi plus 57 bpd of 56.8° API gravity condensate per million.

In the Miocene, a well was being drilled in January in Cameron County; Pan American Petroleum Corporation Milton E. Wentz 1, located eight miles south of San Benito, is permitted to 17,000 feet for a thorough test of the Miocene section.

The shallower south Texas Miocene will continue to receive a good play in 1961, since multi-sand possibilities provide an attractive exploration target. (Jay R. Endicott, Jr., District Geologist, Cosden Petroleum Corporation, Corpus Christi, Texas)

Upper Texas Gulf Coast area. Frio, Yegua, Wilcox, Miocene and Edwards prospects will continue to be sought in 1961 in Railroad Commission District 3. Activity has slackened in recent years, partly because formations formerly drilled at shallow or moderate depths are now prospective only in deep, downdip positions; independent operators now hesitate to drill for them since costs are so high.

The most attractive play in 1961 will continue to be the search for gas-condensate in deep, north-dipping fault blocks in lower Frio beds (below *Textularia mississippiensis)* in the coastal counties (World Oil, November 1960, pp. 123-126). Because of its depth, this is primarily a major company play.

Since publication of the McQueen article on District 3 activity (World Oil, November 1960, pp. 119-122 and 126), the Wilcox trend has been further enhanced by westward extension of the Standard of Texas Lenoir M. Josey Inc. 1 gas-condensate discovery in the Wilcox below 11,300 feet in Harris County. Wilcox prospects are enhanced northeastward throughout District 3 through Jasper and Newton counties and into Louisiana.

The Louisiana Wilcox group is expected to receive considerable attention in 1961. The major part of this will be concentrated on the uppermost Wilcox sand in the Winn Parish vicinity in north-central Louisiana. Excellent production of high-priced oil from shallow depths (1,300 feet in Colgrade field) will continue to arouse interest.

The deeper Wilcox will probably receive the usual drilling in LaSalle, Catahoula, and Concordia parishes. (John H. McCarter, Jr., Geologist, Monroe, La.)

Miocene trends. Although Louisiana drilling is being hampered by regulatory problems and by constantly increasing depths and costs, Louisiana will continue in 1961 to be one of the most active states for exploratory activity, since Miocene oil and gas potential is so great.

U.S. Oil of Louisiana and Mobil Oil Co., Louisiana Land and Exploration Co. S-1, Lake Washington field, Plaquemines Parish was spudded last December. If this

well reaches its projected depth of 26,000 feet, it will be the deepest test in the world.

Texaco Inc. is involved in an active drilling program in its vast acreage holdings in the eastern parishes of Terrebonne, La Fourche, Plaquemines, St. Mary, and offshore. Texaco may be stressing development now partly because of low existing drilling footage rates.

An increasing proportion of exploration in coastal Louisiana is of the vertical type (deeper drilling). Until about two years ago Bayou Sale field, St. Mary Parish, had four oil and gas productive sands down to about 11,500 feet. More recent deep drilling, particularly by Humble Oil & Refining Co. and The Atlantic Refining Co. has proven prolific oil and gas sands down to 15,000 feet, covering a much larger area than heretofore thought. Proven multi-pay production covers about 35 square miles at Bayou Sale.

Apparently due to hydrocarbon migration mechanisms in the Miocene trends, some areas produce much more gas than oil; in others, the reverse is true. Due to current market conditions, the gassier Miocene trends are now enjoying more active drilling. A gas trend in Vermilion Parish is being developed; drilling is especially active in the multi-pay Buck Point field. The gas-bearing updip Terrebonne Parish trend is very active also.

GULF COAST MESOZOIC TRENDS

Edwards limestone (south Texas). Continued emphasis is being placed, especially by major companies, on the search for new deep Edwards limestone (11,000-17,000 feet) fields or extensions of recent discoveries in Karnes, De Witt and Lavaca counties. One well (Shell O'Neal 1) was drilling at a critical depth in northern Bee County at the end of 1960. Several tests are planned for near future drilling in northern Live Oak and McMullen counties. There has been an intensive lease play in the intermediate depth trend through Gonzales, Fayette and Lee and the eastern parts of Bastrop and Caldwell counties. A number of Edwards and Glen Rose or Sligo tests are already under way or are proposed for drilling during 1961.

The shallow Edwards trend in the Luling fault zone of Guadalupe and Caldwell counties will continue to be explored. The old Luling-Branyon, Salt Flat and Darst Creek fields are experiencing an intensive re-development of the Austin chalk and Buda limestone formations. Recently improved fracturing techniques are enabling operators to complete excellent oil wells in these pays where only uneconomical or marginal production could be obtained until recently. This development is extending these fields beyond the limits of the older Edwards production. Salt Flat field has recently been extended into the Luling townsite, where an active leasing campaign is now in progress. Many wells are expected to be drilled here during the next few months. This development probably will also yield additional Edwards production, since no wells have previously been drilled in the townsite to condemn this possiblity.

The lower Cretaceous formations from the middle Edwards down to the base of the Travis Peak sands, lying at moderate depths (3,500-6,000 feet) in the Balcones-Luling fault zone, constitute what is considered to be the most neglected prospective geological province in south Texas. In addition to probable structural traps along known faults, there are reef occurrences in the Edwards and Glen Rose and possible stratigraphic traps in the Glen Rose, Sligo and Hosston formations. Sufficient oil and gas shows have been reported to enhance these formations. Projects under way in Bastrop, Caldwell, Guadalupe and Bexar counties should result in additional exploratory wells being drilled during this year.

Several recent shallow gas discoveries in Anacacho reef limestone will encourage further exploration for similar occurrences above and flanking "serpentine plugs" in Uvalde, Zavala, Frio and Medina counties, and possibly into Kinney County. Exploration continues to be active in the search for new production from Olmos and San Miguel sands draped over these igneous rock masses in Zavala, Dimmit and Frio counties. (Kenneth A. Simmons, Geologist, San Antonio, Texas.)

East Texas enjoyed a prosperous year in 1960, with 53 percent of the total wells drilled completed as producers. This record, along with significant discoveries in the deep Jurassic (Cotton Valley and Smackover) and the lower Cretaceous lime point to a heavy deep drilling and leasing program in Railroad Commission districts 5 and 6 in 1961.

Discovery of 5 Smackover and 3 Cotton Valley fields during 1960 at depths from 9,000 to 13,000 feet indicate heavy leasing and drilling activity during 1961. Emphasis will be on confirmation wells and wildcats on known shallow structures along the Smackover porosity belt.

Discovery of Fairway and West Fairway Fields in northeastern Anderson County, producing oil from the thick James lime pay at an average depth of 9,900 feet should stimulate this area in 1961. Five oil wells have been completed and three rigs are active. The discovery is important because deep production in the James lime stratigraphic position in the East Texas Basin has heretofore been virtually non-existent.

The west flank of the Sabine Uplift, centering around Rusk County, will be active again this year in the search for gas and gas condensate in stratigraphic traps. New markets for gas in this province occasioned brisk drilling last year.

The continued search for Woodbine production in the East Texas Embayment on piercement salt domes and low relief structures will account for considerable shallow drilling.

Shallow Woodbine oil production is expected to be the goal in the Central Graben Area along the Mexia-Talco fault trend. This play was initiated by discovery of Woodbine oil in the Trix-Lix field in Titus County.

The current year appears to be a record period in east Texas, comparable to 1957 in drilling and leasing. (John G. Voight, Consulting Geologist, Tyler, Texas)

The north Louisiana 1961 outlook is somewhat brighter than in previous years. More exploratory drilling and leasing activity is expected in the Monroe gas rock, upper and lower Cretaceous, and Jurassic Cotton Valley and Smackover trends.

Monroe gas rock. The old Monroe gas field in Ouachita, Morehouse and Union parishes is undergoing renewed activity. New completion methods in gas horizons near and within the Monroe gas rock have resulted in new

extension drilling. Most of the new drilling will probably be on the west flank. Wildcat tests are also expected elsewhere on the Monroe uplift. More wells are expected to be drilled to this zone in 1961 than to any other in north Louisiana. Average depth is about 2,200 feet.

In the upper Cretaceous, the Tuscaloosa will be drilled in Franklin and particularly in Tensas Parish where the underlying Washita-Fredricksburg is proving to have excellent potential in Buckhorn field.

Lower Cretaceous. The Hosston formation should receive a good play across north Louisiana from Richland to De Soto Parish. Many new wildcats are expected across northern Jackson Parish where recent discoveries have been made. These gas sands, overlooked in the past, appear more valuable all the time. Depths are moderate—from 4,000 to 10,000 feet, and vigorous drilling activity is forecast.

The Paluxy, Rodessa, Sligo, and other lower Cretaceous formations are expected to undergo an average exploration effort in northwest Louisiana with some increased drilling due to leasing of government land in Bossier Parish.

Cotton Valley. The Calhoun field of Ouachita Parish is continuing to attract attention to the Cotton Valley zones as well as to Hosston and other younger formations. The field should remain very active due to multiple proven reservoirs. Production has been obtained from the Davis, Vaughan, Bodcaw, "D", "C", Cadeville and Chapman sands—all below 9,000 feet. The Cadeville is the richest, producing from 200 to 300 barrels of condensate per MMcf. This sand seems thicker off the highs and its limits have not been determined.

Attempts will be made to extend the Cotton Valley trends both east and west. A test is proposed to the east in Richland Parish and some to the southwest in Jackson Parish.

Little Smackover drilling is expected in north Louisiana. However, a proposed test near Ruston field, Lincoln Parish, may prove interesting. (John H. McCarter, Jr., Geologist, Monroe, La.)

Mississippi. In 1960 emphasis continued on search for lower Tuscaloosa oil in the Mississippi embayment area of Lincoln, Pike, Franklin, and Amite counties. Both Little Creek and McComb fields, recent major discoveries, have proved to be structural-stratigraphic type traps with a permeability barrier across a structural nose. As a result, every structural nosing and terrace has become the object of intensified drilling. Average depth of wells in the lower Tuscaloosa play is 11,000 feet; cost of a dry hole is approximately $70,000; length of time to drill varies from 20 to 30 days. A high level of exploration is expected during 1961 as subsurface control increases to aid in locating wildcats.

Lower Cretaceous drilling in 1960 was down slightly from 1959. However, out of 64 wildcats drilled primarily for lower Cretaceous objectives, seven resulted in discoveries. Of special interest were the Paluxy gas discoveries in Marion and Walthall counties, which sparked the drilling of several additional deep tests in the area.

The most significant lower Cretaceous test of 1960 was the Humble Thompson 1 located on the Bentonia structure southeast of Tinsley field. This well tested high gravity oil from three sands and apparently has given Yazoo County its first commercial lower Cretaceous production. This discovery is certain to revive interest in this portion of the lower Cretaceous "fairway." The outlook for 1961 is an increase in exploration in this trend.

A flurry of activity occurred in the shallow updip Eutaw (Eagle Ford) area in 1960. First oil production from the Selma chalk in Mississippi was found in Clarke County west of Langsdale field. Two additional discoveries, both Eutaw pays, were found on the Quitman-Langsdale fault trend.

For Mississippi in 1961, with available markets, generally favorable allowables, and the recent establishment of 80-acre spacing for oil, the outlook is one of continued rapid development of lower Tuscaloosa discoveries and a probable increase in over-all wildcat activity. (Verne Culbertson and James W. Proctor, Geologists, Jackson, Miss.)

Florida. Exploration for oil continues at a slow pace. In northwest Florida deep wells seek production in Cretaceous sands productive in Mississippi and Alabama. In southern Florida the state's only oil production, at Sunniland field in Collier County, is from porous Cretaceous limestone and dolomite. A recent test drilled by Humble Oil & Refining Co. near Sunniland field found several deep Cretaceous oil zones which are being tested for possible commercial production.

Average well depth in 1960 was more than 13,000 feet; the deepest well completed last year reached 15,294 feet, close to the depth record of 15,475 set by Gulf Oil Corp. in 1959. Exploratory efforts along the west coast of Florida are increasing, and the major exploratory effort in 1961 is expected to be concentrated in this region (Joseph E. Banks, Senior Geologist, Coastal Petroleum Co., Miami)

WARRIOR BASIN

After several years of only sporadic exploration, there are indications of renewed interest in the Black Warrior Basin of northeast Mississippi. The technique of drilling with gas is helping to meet the problem of penetration in this "hard rock" area, making the shallow Pennsylvania and Mississippi pays more attractive targets. (Culbertson and Proctor, Jackson, Miss.)

About a dozen wildcat wells are expected to be drilled on the Alabama side of the Warrior Basin in 1961. One or two may have commercial potential in the Bethel (Mississippian) sand or deeper beds. Good completion methods, including good cement jobs and careful perforation and sand fracturing are required for success (Robert C. MacElvain, Assistant State Oil and Gas Supervisor, University, Ala.)

MID-CONTINENT

West Texas seems rather devoid of new exploratory trends. The Pandale trend in the Val Verde Basin, highly touted several years ago, has quieted, since lower Paleozoic formations apparently change unfavorably eastward in Val Verde County. Some deep drilling, especially for prolific gas reserves, is underway. Three rigs were running in Brown-Bassett gas field, Terrell County, last month.

Farther north in Terrell County, Gulf Allison 1 appears to have found oil and gas in the Strawn between 11,000 and 12,000 feet.

In the Delaware Basin, 33 miles northwest of Fort Stockton, Atlantic Refining Co. completed Kelly 1 in three Paleozoic zones between 15,830 and 16,680 feet at rates indicating a combined daily flow of about 30 MMcf. Tests were on a half-inch choke.

Although some big gas wells were being completed in the Delaware and Val Verde basins, drilling and completion costs are very high; some of the gas contains considerable percentages of non-combustibles; and in some cases interstate gas movement is hung up due to delayed rate proceedings. Large ranches, which often necessitate bonus payments for blocks of 100,000 acres before exploration can start, are also a retarding factor in West Texas exploration.

The Delaware sand trend from Marsh field on the Culbertson-Reeves county (Texas) line northeastward through Mason North field into Lea County, New Mexico, continues active, with independent operators following stratigraphic traps from one well to the next.

In southeast New Mexico, stratigraphic traps will play a more active role in initiating lease plays and drilling activity in 1961. The Pennsylvanian section has produced stratigraphic accumulations and should receive more attention. The Delaware sands should be an active exploratory target.

The poor success ratio in searching for Delaware sand fields has been overshadowed by economic advantages:

- Farmouts with sufficient acreage and dry hole money can be easily obtained
- Drilling is relatively shallow (3,000-5,000 feet)
- Recent discoveries such as Paduca and El Mar have produced high reserves with a very attractive return-on-investment.

Prolific pays in the Abo Reef and Pennsylvanian gas sands have increased exploratory interest. Success along the Abo Reef trend has contributed greatly to drilling activity in 1960. Reef exploration should continue in western Eddy County and along the Artesia-Lovington trend in 1961. Drilling should be especially active in exploiting the recent Standard of Texas Vac Edge Abo Reef discovery in Lea County. (See WORLD OIL, December 1960, pp. 91-95).

An undersaturated market and favorable price for gas should spur increased exploratory interest in the Pennsylvanian gas sands. This multi-pay prospect, in the past, has been only a secondary objective in the drilling of Devonian prospects. Recent success along the Artesia-Lovington trend and in the Delaware basin has upgraded these erratic sands as a primary target for exploration. (William J. LeMay, Geologist, Hondo Oil and Gas Co., Roswell)

In north Texas, 1960 predictions (by Frank Conselman in WORLD OIL) regarding Hardeman and Menard counties have been vindicated by two recent discoveries. Shell Conley 3, Hardeman County, seven miles west of Chillicothe opened production from the Palo Pinto reef in addition to the regular field pay (Chappel Mississippian). The well was dually completed for 182 bopd from the Palo Pinto at 5,210-5,240 feet and for 200 bpd from the Mississippian at 7,861-71 feet.

In Menard County, J. R. McLean et al Alex Menzies 1, located 12 miles northwest of Menard opened the Wilhelm Lane field. The producing zone (from 3,198 to 3,204 feet) is either of Canyon or Strawn age. Initial production was 123 bopd plus 5 percent water, flowing.

At the end of 1960 the new field had 13 producing wells. Dry outposts had been drilled, one each on the northeast and southeast. This is the first sizable commercial production in this area. The Cook sand (upper Cisco) has potential in the same part of Menard County at 2,000-foot depths.

Hence, Menard and Concho counties may be expected to receive much wildcat drilling and leasing attention from independents. Fisher and Nolan counties will receive attention from both majors and larger independents for Strawn and Canyon reef zones as well as shallower zones (e.g., Tannehill [Wolfcamp] sand).

The shallow "bread and butter" play for strat traps and channels will continue, mostly in Jones, Taylor, Coleman, and Shackelford counties. Zones range from Strawn to Permian. In addition to core drilling, surface mapping (still a good method) and subsurface geology, re-entrys into old wells are popular. The Strawn play in north central Taylor County (Goen and Fry horizons) will continue.

New outlets for gas may be obtained in 1961; this would encourage exploration. Erath and Comanche counties appear to be in for increased gas search, and the Palo Pinto gas play will continue. Bend conglomerates and Marble Falls lime are the main objectives. Areas east of these counties are of lessening interest.

More leasing and drilling are planned by north Texas operators in 1961 than at the start of 1960. Farmouts from the larger lease holders are also easier to obtain. (H. P. Wells, Jr., Geologist, Abilene, Texas)

Oklahoma. The oil and gas industry in Oklahoma is on the march, with drilling activity intense mainly in the gas producing areas of the Anadarko and Arkoma basins. Although wildcat completions decreased in 1960 about 16 percent under the previous year, average well depth increased about 25 percent. The trend is for deeper drilling in all parts of Oklahoma. Increased pressures with depth afford greater gas reserves to justify deep drilling. A total of 46 new gas fields and 50 new oil fields in 41 counties were reported in 1960. The time is ripe for new gas pipe line outlets.

Gas developments and reserves in the Anadarko and Arkoma Basins are most significant and will receive the greatest attention during 1961. In the large oil producing area of central Oklahoma many gas wells were plugged for lack of a market. This area, as well as many others in Oklahoma, can be revived by new outlets.

Anadarko Basin. The northwest shelf, which includes 12 counties, netted 14 new oil and gas finds in 1960. Discoveries are in the Tonkawa and Cherokee sands, Mississippi lime, and Marmaton and Chester sands and limes. Development continues in the deep Siluro-Devonian (Hunton) lime gas producing areas in Dewey and Chester counties.

The large oil and gas producing area of Kingfisher County along the east flank of the Anadarko Basin continues to spread, and now extends into Garfield County;

it may spread further into Major and Blaine counties and possibly into Canadian County.

To the north are four new Simpson-Wilcox sand discoveries in Garfield and Grant counties. To the south a very significant Simpson-Bromide sand find is Cleary, Calvert, and East, Milltop 1, S16-T8N-R5W, Grady County, completed for 30.5 MMcfpd with 10 barrels of condensate per million from perforations 11,715 to 11,810 feet. Deeper drilling in this part of the basin is forecast.

The south rim of the Anadarko Basin has a new gas discovery in the Springer at Southeast Apache, S35-T5N-R11W, Caddo County; initial potential was 3.3 and 10.8 MMcfpd from 7,519 to 7,603 feet and from 7,928 to 8,206 feet respectively. The Springer sands are prime targets for deep drilling. Attention is now being directed to the deeper portion of the Anadarko Basin—tests below 15,000 feet are planned.

The western rim of the Anadarko Basin in Cimarron County in the Panhandle had a Morrow sand discovery in S10-T3N-R9ECM. Greater interest in Cimarron County is expected in 1961. Permian-Red Cave production developing in Hutchinson, Moore, and Potter counties in the Texas Panhandle may spread into Oklahoma.

Southern Oklahoma. East of Fort Sill in Comanche County, Woods Petroleum Company Wilson 1, S20-T3N-R9W found three-zone gas production in Pennsylvanian-Hoxbar sands. South of Oklahoma City in the area of Cleveland, McClain, and Pottawatomie counties are nine discoveries in the Hunton and Viola limes, and Bromide-Wilcox, Tulip Creek and Oil Creek sands. The most important of these finds is Herman Brown Kunkler 1, S24-T9N-R1W in eastern Cleveland County. New Arbuckle lime production in S16-T8N-R2W and a Viola lime discovery in southeastern Cleveland County are also important.

The Arkoma Basin, which produces dry gas is the most important area of current development in Oklahoma. The shallow Hartshorne sand, at the top of the Atoka is the old producing zone on the anticlinal folds. Present development includes deeper drilling to Atoka and Morrow sands.

In the Arkoma Basin there were 10 gas discoveries in 1960. Four discoveries were in shallow Pennsylvanian sands in Pittsburg and McIntosh counties. Four were from the deeper Atoka sands in Latimer and Haskell counties. One was from the Hale sand in the Morrow formation in Sequoyah County, and one in Atoka sands in northeast LeFlore County. At present the outstanding developments are the lower Atoka sand wells on the Brazil anticline and the east end of the McAlester anticline in Latimer County, and on the Kinta anticline in southern Haskell County.

The Atoka sands range from 5,000 to below 11,000 feet. The Arkoma Basin is destined to become one of the major gas-producing areas in the United States. The Ouachita Mountains and the overthrust belt south of the Choctaw fault in southeastern Oklahoma is another prospective gas province with two discoveries in 1960. The Sinclair Reneau 1, S32-T3N-R20E, Latimer County, found gas in the Big Fork chert (Viola) at 2,340-2,410 feet. The King-Stevenson Brame 1, S35-T3S-R15E, Pushmataha County, is also a gas discovery. [Gene (E. P.) Neal, Independent Oil and Gas Consultant, Tulsa]

Arkansas. Two 10,000-foot tests scheduled late in 1960, one in Yell County and the other in Lonoke County, will influence the pattern of exploration for dry gas in the Arkansas Valley. The Yell County well, intended to be an Atoka-Morrow test, is only about 10 miles north of pre-Atoka Ouachita facies outcrops. The Lonoke County well, in the Gulf Coastal Plain, is slated to test appreciable Paleozoic footage, probably of Ouachita aspect. Any encouraging results will focus attention on the entire southern Arkansas Valley-frontal Ouachita region of the state.

The non-producing eastern part of the valley should see some activity also, but the trend toward the frontal Ouachitas is expected to predominate.

The south Arkansas oil country probably will follow the same pattern as last year with new oil and gas production being added from a variety of Cretaceous and Jurassic pays rather than from concentration on a particular trend. (William M. Caplan, Geologist, Arkansas Geological and Conservation Commission, Little Rock, Ark.)

Kansas. Although exploratory activity in northwestern Kansas during 1960 was neither so intense nor successful as in 1959, prospects for continued exploration in the region were enhanced by announcement of two large drilling programs. The Lansing-Kansas City group at about 4,000 feet will remain the prime target of most future wildcat test holes in the northwest part of the state.

In southwestern Kansas new discoveries will be made, and development drilling along the Eubank-Pleasant Prairie trend in Haskell and Finney counties will continue in 1961. Pennsylvanian and (especially) Mississippian rocks below the Hugoton gas zones (restricted to Permian rocks) hold the most promise of major new reserves. Development of deeper zones in the Kansas portion of the Anadarko basin has been and will continue to be inhibited by shallow lease holders.

In eastern Kansas, there will be an intensive search for new reserves in the well established areas (Cowley, Sumner, Butler, Sedgwick, and Marion counties). Such finds as Shannon field in Cowley, and Paulson in Butler, along with development in Lost Springs field, Marion County will stimulate exploration for Pennsylvanian and Mississippian reservoirs near the Nemaha Anticline in southern Kansas.

The drilling pace should also be accelerated along the northern end of the Nemaha Anticline, as potential stratigraphic and structural traps on the flanks are explored. A few sub-Pennsylvanian tests are expected in both the Cherokee and Forest City basins. (J. M. Jewett and E. D. Goebel, Geologists, Kansas Geological Survey, Lawrence, Kan.)

Williston Basin. The 1961 Williston Basin outlook indicates scattered wildcatting, with the greatest activity centered around development drilling near certain fields. A few recent discoveries may modify this picture.

Most important of the discoveries is the Murphy Corp. success in recovering oil in the Niscu formation (upper Devonian) in the Tule Creek area of northeastern Montana. A parallel finding of Niscu oil in Charleson field

on the Nesson Anticline has enhanced this formation, especially in shallow areas in Montana. Another recovery of Devonian oil was made in Bear Den field, south of Charleson field. Development of Mississippian oil in Dwyer field, northeastern Montana near the North Dakota border also portends new interest.

A Hunt Oil Co. discovery of Madison oil, if followed by more successful drilling will activate a hitherto sparsely drilled area in Billings County, North Dakota. A new Spearfish oil discovery adjacent to South Westhope field in northern North Dakota will cause more drilling in 1961.

Eastern Montana is now the most active area in the Williston Basin and portends to remain so in 1961.

On October 31, 1960, Murphy Corp. completed Sletvold 1, S18-30N-48E, Tule Creek area for 476 bopd, 42° API gravity oil from the Devonian Niscu formation at 7,660-7,676 and 7,686-7,692 feet. The oil trap is a combination of structure and stratigraphy.

As of mid-December there were 6 drilling wells and 12 new locations in the area. Two dry holes had been drilled by January 7. The drilling for Devonian oil in the relatively shallow part of the Williston Basin in Sheridan County, Mont., is expected on the basis of this discovery.

Developments in the Dwyer field in T32N-R59E, Sheridan County, Mont. are of interest. The similarity of a nosing structure at Dwyer to the Tioga field structure on the Nesson Anticline in North Dakota is notable. Production at Dwyer is from a Madison zone equivalent to an oil-producing zone in Tioga.

North Dakota. In 1960 about 60 percent of the drilling in this state was in Burke, Bottineau and Renville counties, located east of the Nesson Anticline and along the Canadian boundary. More than three times as many development wells were drilled as wildcats. A total of 290 wells were drilled in the state.

Burke County's Black Slough field has seen further development of oil from Mississippian formations in late 1960 and promises considerable activity in 1961. A new Spearfish oil discovery by Cardinal Petroleum opens a new area for development, southeast of the South Westhope oil field in eastern Bottineau County.

The southern Nesson Anticline area will have slow but steady development work for Madison and deeper reserves; and scattered wildcatting will continue in 1961.

Amerada Petroleum Corp. has a new well a mile west of the Scoria oil field, Billings County, recovering oil from the Madison. It appears to be the beginning of a new development in the area. Scoria field is a Tyler (Pennsylvanian) sand oil producer.

In 1961 North Dakota should have more than 100 new wildcat wells and 250 development wells, mainly in the northern part of the state. The figures suggest a slight increase over 1960. Improved market conditions with increased allowables implies more activity.

North Dakota had its largest lease sale in history in 1960. Response was good. Though buying was, of course, heaviest in the vicinity of new oil fields, bids were made on almost all tracts offered.

South Dakota. Ziebach County on the southern flank of the basin in north central South Dakota is being watched. Here Amerada Petroleum has an extensive lease spread and has drilled two of an expected series of exploratory wells. Both attempts were dry.

One or two wildcats may be drilled in 1961 on the extreme west side of Harding County.

The Canadian portion of the Williston Basin in southern Manitoba and Saskatchewan appears to be in for slow activity in 1961. The last half of 1960 saw twenty active rigs drilling development and step-out wells. Two wildcat wells drilled since September failed to test pre-Pennsylvanian formations.

The Manitoba and Saskatchewan portions of the Williston Basin had about 10 new 1960 discoveries. These were mainly in the areas of Carduff, Elmore, Forget, Portal, West Parkman and Radville oil fields. New production is from Frobisher, Midale and Tilston beds (Mississippian). A new wildcat discovery east of Steelman field in southeastern Saskatchewan is arousing interest in that area. (Frank W. Foster, Geological Consultant, Boulder, Colo.)

ROCKY MOUNTAIN AREA

Exploration in Wyoming in 1961 will be along the same general lines as 1960; i.e., major emphasis on the northeastern Powder River Basin and in the Green River Basin in the southwestern part of the state. Continued successes in both areas have enhanced future possibilities of both; exploratory drilling will progress, and to greater depths.

In the Crook and Campbell counties sector of the Powder River Basin stratigraphic traps in the Cretaceous Muddy and Dakota sands have yielded profitable oil fields at Donkey Creek, Coyote Creek, Miller Creek and Rozet. These will be probed for extensions or kindred accumulations nearby. The deeper Pennsylvanian Minnelusa sands are likewise yielding new commercial discoveries, as at Raven Creek in eastern Campbell County.

Recent discoveries on the west side of the Powder River basin in shallow Tensleep at East Tisdale will doubtless cause a re-examination of known structures and nearby producing areas in that section of the state also.

The Green River Basin region along the eastern flank of the Rock Springs Uplift, Sweetwater County, has yielded good oil fields along the Patrick Draw trend, and, recently, an extension of Table Rock. Production here is mainly in the Almond sands of the Cretaceous Mesa Verde series. Farther west in this tremendous basin, gas is found in deep Dakota and shallower sands of the Big Piney district.

Scattered elsewhere in the state, a deep discovery of Muddy oil and possible Lance gas production along the southern flank of the Wind River Basin will spark new drilling in this territory. A new Tensleep oilfield at South Polecat resulting from a fortuitous combination of anticlinal structure, tilted water table and sand facies changes will cause more wildcatting around other structures for similar oilfields in the Big Horn Basin.

Stratigraphic variations of the generally known producing horizons continue to be a dominating cause for the finding of new oil and gas fields. Stratigraphic traps have been recognized and sought in the Cretaceous and younger formations, but this principle is now becoming more apparent in the older formations too. The Pennsylvanian Tensleep sand is running the full course of typical exploration history.

In the early days, anticlinal structures of 500 feet or more closure were thought to be necessary for Tensleep production. Later, features of 150 feet closure were acceptable prospects, then hydrodynamic tilts pushed the oil fields off closures entirely. Finally, facies changes in the sand itself are being recognized as reasons for possible accumulation of Tensleep oil.

Wyoming is sharing in the national slowing down of exploration but perhaps, percentagewise, it is relatively more active than many other sections. This position is expected to be maintained throughout 1961. (William H. Curry, Geologist, Casper, Wyo.)

Southern Nebraska Pennsylvanian play. One of the most encouraging developments in the Rocky Mountain area in 1960 was the development of really profitable production for the first time in the southern Nebraska Pennsylvanian section in Red Willow, Hitchcock, and Dundy counties. A small discovery in Yuma county, Colorado, is also part of this play. In 1961 Nebraska will get the lion's share of this exploration effort, and there will be some activity also in northwestern Kansas and northeastern Colorado. Objectives will continue to be the Lansing-Kansas City limestones, contact zones at the base of the Pennsylvanian and, to a lesser extent, pre-Pennsylvanian rocks in the southwestern Nebraska embayment. A 1½ million acre lease play by a major company in southwestern Nebraska counties bordering Kansas has expanded the prospective area.

The Denver-Julesburg Basin will continue as active in 1961 as it was last year. The Nebraska part of the basin will be favored over that of Colorado due to better recoveries in the former. Acreage is still tight although some farmouts are available. The D and J (Dakota) sands will be the prime objectives, although some search for Lyons sand production will be made.

Eastern and southeastern Colorado should continue to get attention for Pennsylvanian and Mississippian objectives. In December a number of multiple farmouts were under way. This play has never quite gotten off the ground but optimists who like it may be rewarded in 1961. (Edward A. Koester, Petroleum Geologist, Denver)

Northwest Colorado. New interest in oil-producing zones in the Niobrara shale has resulted from recent extensions in Tow Creek and Sage Creek fields. Renewed activity is thus expected in Rouett and Moffat counties in the southeast fringe of the Washakie Basin.

In the Paradox Basin, one of the most vigorous exploratory plays in the United States continues to develop oil and gas-condensate production from Mississippian and Devonian pays on elongate salt structures in Utah and Colorado (World Oil, November 1960, pp. 89-91). Successful completions on the Lisbon anticline have resulted in a multi-million dollar scramble to test neighboring structures.

Evaporite rocks in the middle (salt-bearing) unit of the Paradox member of the middle Pennsylvanian Hermosa formation, locally 7,000 feet or more thick at the end of salt deposition, have moved into the cores of five narrow northwest-trending salt anticlines with amplitudes of 7,000 feet or more. From 5,000 to 6,000 feet of the growth is of late Paleozoic age. The anticlines occupy an area about 100 miles long and 30 miles wide near the axis of a deep, northwest-trending depositional trough bordered on the northeast by the Uncompahgre uplift and on the southwest by an old shelf area.

Stratigraphic units in the upper Hermosa, Rico formation (middle Pennsylvanian), and Cutler formation (Permian) thin toward the evaporite cores and are locally absent. Growth of evaporite cores in middle and late Pennsylvanian time was initiated while the area was covered by a sea. (Donald P. Elston, U.S. Geological Survey, Denver)

In the Four Corners area, drilling for gas in the Pictures Cliffs, Mesa Verde, and the underlying Dakota is leveling off to a steadier rate, with intermittent surges caused by oil discoveries, often in the Gallup sandstone. (World Oil, May 1960, pp. 149-155)

South of Aneth field near the Arizona line in Utah, Champlin Oil and Refining Co. appears to have a good new oil discovery in the Pennsylvanian Ismay zone.

Other areas in Utah. The Uintah Basin contains the Red Wash oil and gas field, with 200 million barrels of reserves, indicating a potential as great as either Lisbon or Aneth. With a number of shut-in gas fields and good prospects for new finds, the Uintah Basin should be one of the nation's great gas areas.

FPC approval of the El Paso Natural Gas line from Rock Springs, Wyoming to California, crossing the western part of the Uintah Basin will provide an outlet for many dormant gas fields.

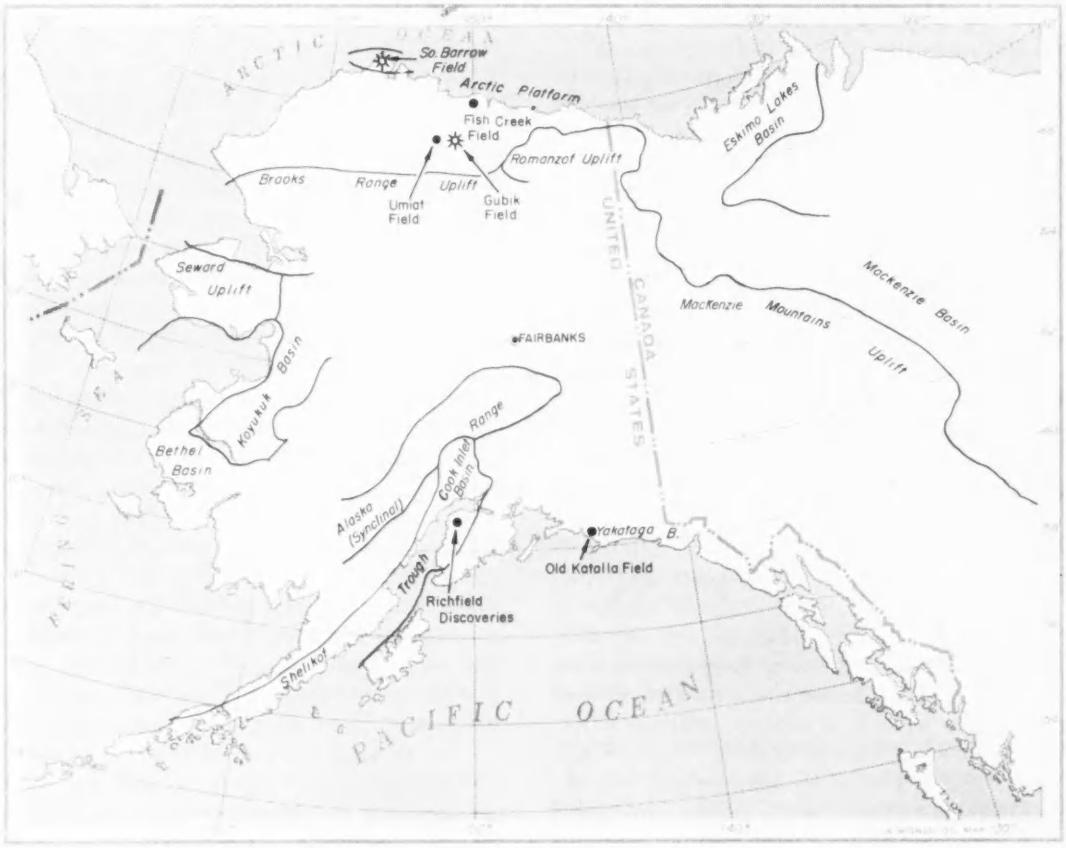
South of Red Wash, development will proceed in several gas fields, notably Texaco Inc.'s Fence Canyon Unit on the south rim of the Uintah Basin where gas was found in the Cedar Mountain (lower Cretaceous). Known gas and oil fields are largely in stratigraphic traps at 5,500-7,500-foot depths in lower Eocene and upper and lower Cretaceous.

Nevada. The few wells drilled in western Utah and Nevada in 1960 in the Basin and Range province were disappointing. Several holes are projected in 1961 in Nevada by major companies, and Shell Oil Company is to drill some new wells in Eagle Springs oil field, sixty miles southwest of Ely, Nev. (Dorsey Hager, Consulting Geologist, Salt Lake City)

Northwestern Arizona is expected to have increased activity in 1961. Some leasing and exploratory work was completed last fall. Several wildcats are scheduled in 1961 to test the complete Paleozoic section. (World Oil, September 1960, pp. 98-106)

Increased wildcatting activity is planned for the Mogollon Slope areas. Helium activity will reach its peak in 1961 along the east end of the Mogollon Slope. At least 30 wildcats and 10 field wells are scheduled for an area extending 50 miles from a point northwest of Holbrook eastward to Sanders, following announcement of a new helium plant at Navajo. (Silas C. Brown, Geological Consultant, Scottsdale, Ariz.)

Sedimentary basins, oil and gas fields in Alaska



PACIFIC COAST AREA

Sacramento Valley. Greater drilling records seem certain to be set in the Sacramento Valley of northern California in 1961. Low-cost Eocene-Paleocene pays will continue to be an attractive target, though not so significant reserves-wise as the Cretaceous ones.

In the upper Cretaceous an expanded effort will be made to seek production on the eastern side of the valley in the Starkey and Winters sands which have not yet enjoyed a concerted program. Shallow Kione and low-cost Blewett, Tracy, and "E" zone sands will contribute additional gas reserves. Continued development of the "F" zone sands and a rapid expansion of exploration for them is very significant from the reserves standpoint.

The unexpected discovery of oil in a Winters gas field well has enhanced this 50-by-200 mile dry gas producing area. In 1960 there were 239 completions, an increase of 38 percent over the high 1959 activity; footage in 1960 also increased 59 percent over 1959. Eleven new gas fields were found in 1960, three in Paleocene and eight in upper Cretaceous formations.

Alaska. Exploration activity in Alaska will continue to be concentrated in the chain of Tertiary basins along the Pacific and Bering Sea coasts. Most footage will continue to be in the Cook Inlet Basin, dominated by the Kenai with its proven oil and gas fields being further extended and several wildcats being drilled. The lack of success in wildcats drilled in the Gulf of Alaska Tertiary Basin will probably result in a decrease in activity there, which will be offset by drilling in the Bethel and Bristol Bay Tertiary basins. Pan American Petroleum Corp. was moving a rig onto their Napatuk Creek 1 in December. This very important test will be the first in the Bethel Basin. The Bristol Bay Basin will probably see geophysical activity in the Nushagak and Port Moeller areas and possibly some drilling.

Secondary interest will be centered in Cretaceous exploration with probable drilling in the Copper River Basin and the Kandik area of the Yukon Flats Basin. Considerable geological and geophysical activity can be expected to continue in these two basins and in the Umiat Cretaceous Basin on the Arctic Slope.

Any pre-Cretaceous exploration done in 1961 will probably be limited to surface geology and geophysics, although it is possible that the lower Mesozoic and Paleozoic may be penetrated by drilling in the Kandik area. (Waring Bradley, Consulting Geologist, Anchorage)

CANADA

Exploration in Canada is enhanced by excellent prospects, particularly in Alberta and the Northwest Territories; but it is being retarded by the oversupply of crude, restricted markets for gas, by heavy oil imports into the main (Montreal) consuming areas, and by the remoteness and difficult operating conditions in many of Canada's prospective areas.

In the Arctic Islands, some experimental core-drilling is said to be scheduled for Axel Heiberg Island this year. Photogeologic and field studies will be checked by geophysical work. (World Oil, July 1960, pp. 103-107, and February 1, 1961, pp. 27-32)

British Columbia-Northwest Territories. A vigorous wildcat drilling play is underway this winter from Fort

Nelson northward into the Northwest Territories, primarily for gas in the middle Devonian reef at depths of 6,500 to 7,000 feet. Western Natural Gas Company Fort Nelson 3 found 300 feet of gas pay in this zone, and is indicative of the pay zones being found. Recent proposals to extend pipe line outlets north of Fort Nelson to tie into Kotcho, Petitot, and Celibeta gas areas have also spurred activity. Drilling operations are essentially limited to the winter freezeup period, and relatively warm weather late in 1960 slowed activity.

In Alberta, drilling will remain active in the Swan Hills, Virginia Hills, Kaybob, and Simonette Devonian reef areas.

The Foothills area in the extreme southwestern portion of the province may have received an important oil discovery, unofficially reported at 2,000 bopd, by Shell in the Waterton field area. Reportedly oil was found between 11,000 and 12,000 feet in the Mississippian, down-flank from gas production. This trend, which extends north-northwest through Panther River where Mississippian gas is found at about 7,000 feet, is fraught with intricate overthrust geology, hence costs and risks are high.

Saskatchewan. At least 30 rank wildcats are expected to be drilled to the Devonian and lower Paleozoics in both productive and barren areas across the southern portion of the province. These wells will average perhaps 7,000 feet in depth. Several oil shows have been found in the Devonian in these areas, as well as some teasing occurrences in the Ordovician; and some people are forecasting 1961 as the year of discovery in one or more of these deep tests. (Jas. T. Cawley, P. Eng., Deputy Minister of Mineral Resources, Regina, Sask.)

Eastern Canada. The most timely area of interest is eastern Lake Erie's offshore gas development. At the end of 1960, a total of 104 offshore wells had been drilled in this region, including 77 gas producers, 17 of which are abandoned. Place Gas and Oil Ltd. and Long Point Gas and Oil Ltd., the main operators, both plan active programs in 1961 with their own bottom-based drilling towers and cable tool rigs. Long Point has 13 producers in the Port Maitland area, each averaging about two MMcfpd natural initial potential.

El Paso Natural Gas Products Company earned a half interest in Mineral Exploration Corporation's 37 licenses aggregating about 175,000 acres by drilling three wells last year. Situated five miles apart, these wells indicate a possible gas-bearing trend about 12 miles long or more. One was rated at 422 Mcfpd at 1,125 feet and another tested 300 Mcfpd at 1,037 feet from the Red and White Medina sands. Details of the third test had not been announced. El Paso has increased its holdings to 80 permits covering about 400,000 acres in Lake Erie from the tip of Long Point eastward to across from Buffalo, N. Y.

El Paso worked in 1960 with bottom-based cable tool drilling towers and also with a drilling vessel. The company plans to experiment with rotary tools in Lake Erie this year. (Bryson C. Donnan, geologist, Clarkson, Ont.)

NORTHEASTERN UNITED STATES

Michigan Basin. Preliminary 1960 statistics indicate a record year. There was a 38 percent or higher increase in drilling activity compared to 1959. This includes 965,353 feet of exploratory drilling, and 2,150,579 feet of development drilling (including facility wells). New discoveries include the following:

- Two Devonian discoveries
- Three new Silurian reefs
- Two new Salina pools, including one by deeper drilling in an old Devonian Traverse lime field
- In the Ordovician, one new Trenton-Black River gas pool; one new oil pool in what had been considered as a Trenton-Black River gas field; one new producing formation, the Oneota dolomite, equivalent to the Arbuckle lime; and seven new extensions to the Albion-Scipio trend, extending the length of this trend to nearly 40 miles.

Michigan's 1961 exploratory drilling campaign is predicated on some big "ifs." Should a new trend be discovered, or the two one-well Trenton-Black River fields found in 1959 and 1960 develop into oil fields comparable to the Albion-Scipio trend, then the exploratory drilling surge may exceed 1960's record. Otherwise, it will probably fall short.

The eastern and southeastern parts of the state will be explored for new Silurian reefs. The southern counties will be searched for new Trenton-Black River fields. The western counties will continue to attract those interested in shallow Devonian production, and some effort will be made to find new Silurian pools in this region. The central part of the basin should receive some attention for new Devonian pools, though the northern counties will probably not receive above average activity. (Garland D. Ells, Petroleum Geologist, Michigan Department of Conservation, Lansing)

Illinois Basin. Although exploratory drilling for oil in Illinois has been declining in recent years, new pools continue to be discovered at an average rate of about one per month, mainly in Mississippian formations. There have been some discoveries of deeper producing formations in pools, mostly in Devonian or Silurian limestones.

There is still room for numerous new pools in the deep basin area of southern Illinois. A recent discovery of interest is Birkett and Hurt Silas E. Brookman 1, S3-2S-4E, Jefferson County, eight miles northeast of Mt. Vernon. This well flowed oil at an average rate of 180 barrels per day from McClosky limestone for five days beginning December 8, 1960. It is two miles from the nearest oil production.

In the Christian-Sangamon County area, two new pools of probable significance were discovered in 1960, Springfield East, in Sangamon County, and Blackland North in Macon County, just northeast of Christian County. The latter pool points up the liklihood of continuing the Blackland-Mt. Auburn production trend in Macon and Christian counties several miles northeastward. Many new holes are expected in this general area during 1961. (Alfred H. Bell, Geologist and Head of Oil and Gas Section, Illinois Geological Survey, Urbana)

Reports from Indiana indicate that 1960 was a successful year in the development of shallow oil in Chester (upper Mississippian) in Posey, Vanderburgh, Gibson, Spencer, Warrick, Pike and Dubois counties on or near the Illinois border. Similar activity evidently is to continue at about the same pace.

APPALACHIAN BASIN

More than a dozen major oil companies and a score of independent producers have moved exploration departments into new offices in the Appalachian Basin area. These offices are spread between Evansville and Pittsburgh with about six majors located in Ohio.

Ohio's 1961 outlook. Seismic activity was increased during the past year in several areas, and airborne magnetometer surveys of the eastern half of the state were completed. This year should see the drilling of about 1,000 wells, most of which will reach only the historic producing zones, Mississippian, Devonian and Silurian. Perhaps 50 exploratory wells will test Cambro-Ordovician and of these, about 10 will test the entire section.

In Williams, Fulton and Henry counties, probably about six tests will be drilled to extend Michigan's "Scipio trend" play into Ohio. Of these, perhaps three will be drilled to basement.

Southern Ohio has had a revival of leasing activity. Adams, Scioto and Pike counties will probably have several basement tests during 1961, while Lawrence, Gallia, Jackson, Meigs and Athens counties should have 10 Clinton sand tests and possibly a basement test or two.

Central Ohio will see much of the deeper drilling activity in 1961. Morrow and Delaware counties will probably see five Cambro-Ordovician tests each, Licking County four Cambro-Ordovician and at least one basement test; Muskingum, Guernsey and Coshocton counties one Cambro-Ordovician test each, with at least one of these to reach basement.

Northeastern Ohio will remain busy. Stark, Portage, Geauga, Mahoning, Trumbull and Ashtabula counties may lead the other areas in Clinton sand completions (depths 3,500 to 5,000 feet), and in the light of recent geophysical work could have several Cambro-Ordovician or possibly a basement test (9,000 feet?).

North central Ohio drilling will continue moderately active both in Clinton sand development wells and Clinton wildcats. Cambro-Ordovician and deeper tests will be slowed in the western portion by the three failures completed to the basement during 1960 in Sandusky, Erie and Lorain counties. The 1961 deep drilling outlook for the eastern portion is good especially in Wayne and Medina counties.

Ohio appears to be headed for an average year in total wells drilled, a better than average year in total footage drilled (due both to increase in number of deep wildcat wells and the down-dip search for new gas and oil reserves in Silurian rocks), and possibly a big year in new discoveries. (Lysle R. Kirk, Chief Geologist, The Ohio Fuel Gas Company, Columbus)

West Virginia. Exploration work and leasing activity by the major oil and gas companies has continued to pick up momentum generally during 1960. This trend should continue in 1961. Extensive leasing programs will be limited in the state, due to most of the known geological prospects already having been leased.

Most exploration work by the major oil and gas companies has been pointed to the deeper horizons, including Silurian, Cambrian and Ordovician. Several basement tests will be drilled, but locations will be based on geological and geophysical mapping yet to be done. Reconnaisance and detailed seismic work continues in eastern West Virginia, extending into the west and northwest parts of Virginia.

The major oil and gas companies are now concerned with Oriskany gas prospects. The new independents are confining their exploration efforts to the shallower Mississippian formations (Maxton sands, Greenbrier limestone, Keener, Big Injun, Squaw and Berea sandstones)

There will be continued geologic and geophysical analysis of many known prospects in West Virginia this year. Some new drilling will commence in 1961, with a stepped-up drilling program becoming evident in 1962. (Byron M. Finch, Oil an Gas Consultant, Charleston)

A strong current lease play is reported in Greenbrier County, West Virginia, where Mississippian rocks are on the surface; and a similar one in the Clifton Forge-Covington area of adjoining Alleghany and Bath counties, Virginia, where Silurian is on the surface. Two major companies are reported pursuing this leasing.

In the Maryland Panhandle, a major company is reported leasing in Allegany and Washington counties, east of gas production in Garrett County. The new play is more or less on trend with the Romney, West Virginia area Oriskany sand gas production (from small fault blocks) and not far west of the Blue Ridge.

Western Pennsylvania-New York. Exploration for Onondaga-Oriskany gas production should continue with most of the activity following the Chestnut Ridge anticlinal trend which traverses Pennsylvania and continues into West Virginia. This exploration is primarily based on the search for upthrown fault blocks on either the northeast or southwest flanks of structures.

This year should see an increase in exploration, primarily for Medina sandstone gas in the northwest counties, particularly Mercer and Crawford counties.

A continued increase in leasing by the major oil companies should lead to the drilling of several basement tests, probably in the northwestern Pennsylvania. Exploration for production in the Trenton and deeper horizons in the Cambrian may still be a year away.

In New York state, drilling and exploration activity is increasing with Medina sandstone gas still being the main objective. Several significant discoveries have been made in Ontario and Cayuga, and further exploration may be expected in the middle counties.

During the past year, four exploratory tests have been drilled to basement. The same number, or slightly more, may be drilled in 1961.

The primary targets of sub-Medina exploration in the coming year will be the Cambro-Ordovician contact and Cambrian sections. The basal Trenton (Ordovician) and Little Falls (upper Cambrian) contact zone has shown gas and water from several wells; and the Teresa-Potsdam (upper Cambrian) sections are sandy and coarse dolomitic sections which frequently carry water.

Basement thoughout the central-western counties will be found at depths ranging from 5,000 to 7,000 feet.

Leasing is active in the southeastern counties. Exploratory wells with the Oriskany sandstone and Medina sandstone as their main objective may be expected. (Robert S. Stewart, Huntley and Huntley, Inc., Geologists, Pittsburgh, Pa.)

Forecast of U. S. Wildcat Tests to be Drilled in 1961

State	1961 Forecast	1960 Actual	% Dif.
Alabama	12	10	+ 20.0
Alaska	19	9	+111.1
Arizona	25	22	+ 13.6
Arkansas	127	118	+ 7.6
California	296	294	+ 0.7
Colorado	349	332	+ 5.1
Illinois	619	627	— 1.3
Indiana	341	338	+ 0.9
Kansas	851	900	— 5.5
Kentucky	53	56	— 5.4
Louisiana	521	539	— 3.3
North Louisiana	237	237	
South Louisiana	284	302	— 6.0
*Gulf of Mexico	37	37	
Michigan	238	254	— 6.3
Mississippi	265	250	+ 6.0
Missouri	3	4	— 25.0
Montana	141	143	— 1.4
Nebraska	456	435	+ 4.8
New Mexico	336	344	— 2.3
Southeast	230	240	— 4.2
Northwest	106	104	+ 1.9
North Dakota	48	71	— 32.4
Ohio	48	53	— 9.4
Oklahoma	468	446	+ 4.9
Pennsylvania	33	29	+ 13.8
South Dakota	7	8	— 12.5
Tennessee	59	57	+ 3.5
Texas	3,142	3,300	— 4.8
Dist. 1: South Central	259	322	— 19.6
Dist. 2: Middle Gulf	225	236	— 4.7
Dist. 3: Upper Gulf	269	296	— 9.1
Dist. 4: Lower Gulf-S.W.	384	353	+ 8.8
Dist. 5: East Central	91	112	— 18.8
Dist. 6: Northeast	191	189	+ 1.1
Dist. 7-B: North Central	642	649	— 1.1
Dist. 7-C: West Central	212	228	— 7.0
Dist. 8: West	377	388	— 2.8
Dist. 9: North	415	445	— 6.8
Dist. 10: Panhandle	77	82	— 6.1
Utah	79	81	— 2.5
West Virginia	4	4	—100.0
Wyoming	354	350	+ 1.1
†Other States	27	29	— 6.9
Total United States	8,917	9,103	— 2.1

*Gulf of Mexico wells are included in South Louisiana figures. †Other States include Florida, Georgia, Maryland, Nevada, North Carolina, Oregon, Virginia and Washington.

Wildcat drilling to dip slightly in 1961

FOR THE FIRST time in 11 years, U.S. wildcat activity will drop below 9,000 wells during 1961. According to WORLD OIL estimates, 8,917 wildcats will be drilled this year, down 186 wells or 2.1 percent from the 9,103 exploratory tests drilled last year. The 1960 total represented a decrease of 837 wildcats from the 9,940 drilled during 1959.

The significant decrease in wildcatting last year included a drop of 203 productive completions to 881, and 603 fewer dry wildcats, for a yearly total of 8,222.

The ratio of productive wildcats averaged 1 producer out of every 1.7 wildcats drilled during 1960.

Texas accounts for smaller share. Texas operators will drill 35.2 percent of all U.S. wildcat wells this year, compared with 36.2 percent in 1960 and 44.1 percent during the peak wildcatting year of 1956 when 12,574 wells were drilled in the U.S.

Kansas, the second most active wildcatting state, will decrease its total 49 wells, or 5.5 percent, to 851 wildcats this year, following a 288-well drop in 1960, from the 1,188 wildcats drilled during 1959.

Illinois, which replaced Oklahoma as the third ranking state last year, will continue its ranking in 1961, despite an 8-well decline to 619 wildcats. Oklahoma, now fourth, will record a 22-well or 4.9 percent increase in wildcatting to 468 wells. Nebraska, the fifth most active state, will drill 456 wildcats this year, up 16 wells or 4.8 percent over 1960.

The most promising wildcatting prospects continue to be in the Rocky Mountain region. Particular interest currently is being shown in the play on the western side of the Cambrian Arch in Nebraska.

Results of Wildcat Drilling in United States, by Years

	PRODUCTIVE WILDCATS												DRY WILDCATS			TOTAL WILDCATS		
	OIL			DISTILLATE			GAS			TOTAL PRODUCTIVE								
YEAR	No.	Footage	Avge. Depth	No.	Footage	Avge. Depth	No.	Footage	Avge. Depth	No.	Footage	Avge. Depth	No.	Footage	Avge. Depth	No.	Footage	Avge. Depth
1937	203	831,123	4094	3	19,377	6459	33	77,389	2345	239	927,889	3882	1,943	7,173,550	3692	2,182	8,101,439	3713
1938	229	944,455	4124	4	23,657	5914	31	102,440	3305	264	1,070,552	4055	2,179	7,012,901	3218	2,443	8,083,453	3309
1939	224	782,289	3492	1	7,999	7999	33	103,450	3135	258	893,738	3464	2,488	7,764,816	3121	2,746	8,658,554	3153
1940	262	957,167	3653	2	12,792	6396	46	122,439	2662	310	1,092,398	3524	2,672	8,649,828	3237	2,982	9,742,226	3267
1941	301	1,165,966	3874	3	23,505	7835	58	177,974	3069	362	1,367,445	3777	3,047	9,651,013	3167	3,409	11,018,458	3232
1942	288	1,199,382	4165	13	121,620	9355	48	167,428	3488	349	1,488,430	4265	2,652	9,320,691	3515	3,001	10,809,121	3602
1943	276	1,232,396	4465	15	140,564	9371	56	212,814	3800	347	1,585,774	4570	2,951	10,702,429	3627	3,298	12,288,203	3726
1944	326	1,422,250	4363	32	250,228	7820	102	417,944	4097	460	2,090,422	4544	3,425	13,470,846	3933	3,885	15,561,268	4006
1945	317	1,503,763	4744	30	269,915	8997	113	486,529	4306	460	2,260,207	4913	3,486	14,504,642	4161	3,946	16,764,849	4249
1946	308	1,359,787	4415	29	264,441	9119	75	272,564	3634	412	1,896,792	4604	3,830	14,399,824	3760	4,242	16,296,616	3842
1947	436	1,999,100	4585	44	352,691	8016	96	403,038	4198	576	2,754,829	4783	4,407	17,068,382	3873	4,983	19,823,211	3978
1948	610	2,760,127	4525	70	626,026	8943	112	514,990	4598	792	3,901,143	4926	5,618	22,227,790	3957	6,410	26,128,933	4076
1949	668	3,027,759	4533	69	644,454	9340	130	626,058	4816	867	4,298,271	4958	5,914	22,044,695	3728	6,781	26,342,966	3885
1950	811	3,607,484	4448	67	572,807	8549	137	679,851	4962	1,015	4,860,142	4788	6,876	25,882,014	3764	7,891	30,742,156	3896
1951	992	4,767,425	4806	62	564,243	9101	172	937,257	5449	1,226	6,268,925	5113	8,552	34,526,359	4037	9,778	40,795,284	4172
1952	982	4,751,818	4839	111	1,038,256	9354	174	924,735	5315	1,267	6,714,809	5300	8,972	39,430,757	4395	10,239	46,145,566	4507
1953	1,062	5,322,266	5012	97	833,326	8591	259	1,326,976	5123	1,418	7,482,568	5277	9,325	41,551,971	4456	10,743	49,034,539	4564
1954	1,056	5,525,392	5232	118	997,846	8456	260	1,384,545	5325	1,434	7,907,783	5514	9,387	42,227,607	4499	10,821	50,135,390	4633
1955	1,085	5,625,626	5185	123	1,087,452	8841	236	1,163,846	4932	1,444	7,876,924	5455	10,157	47,707,546	4697	11,601	55,584,470	4791
1956	1,070	5,754,326	11296	110	1,042,679	17480	258	1,512,509	5862	1,438	8,309,514	5779	11,186	50,233,797	4491	12,624	58,543,311	4637
1957	848	4,724,116	5571	120	1,190,984	9925	213	1,235,630	5801	1,181	7,150,730	6055	10,228	46,549,595	4551	11,409	53,700,325	4707
1958	743	4,073,165	5482	80	755,645	9446	226	1,296,860	5738	1,049	6,125,670	5840	8,750	40,296,787	4605	9,799	46,422,457	4737
1959	713	4,003,012	5614	85	822,634	9678	286	1,783,094	6235	1,084	6,608,740	6097	8,856	42,662,522	4817	9,940	49,271,262	4957
1960	564	3,330,539	5905	71	675,652	9516	246	1,509,092	6134	881	5,515,283	6260	8,222	39,857,893	4848	9,103	45,373,176	4984

Results of Wildcat Drilling in the United States in 1960, by States

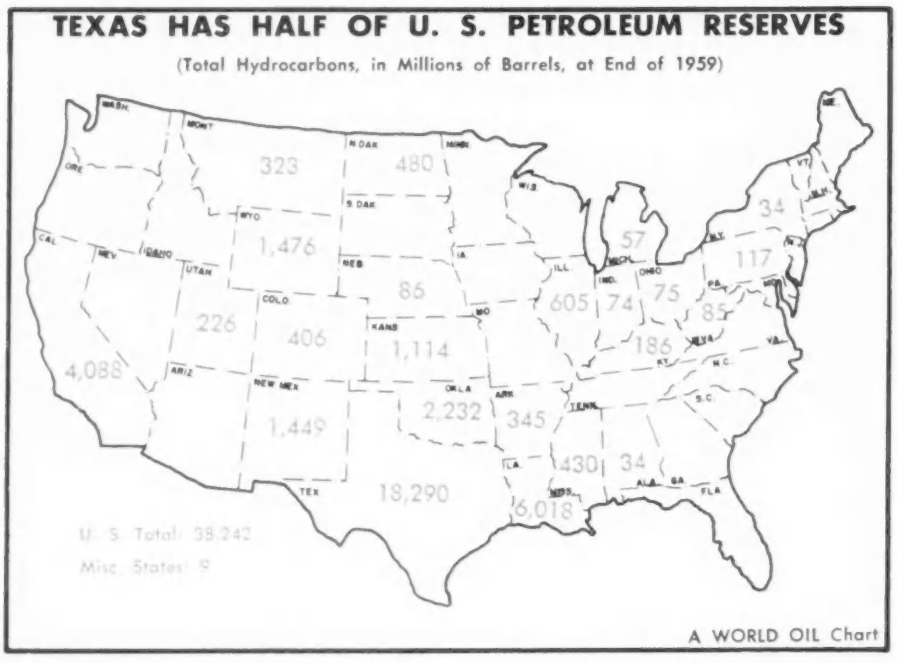
STATE or DISTRICT	PRODUCTIVE WILDCATS: OIL No.	OIL Footage	OIL Avge.	DISTILLATE No.	DISTILLATE Footage	DISTILLATE Avge.	GAS No.	GAS Footage	GAS Avge.	TOTAL PRODUCTIVE No.	TOTAL PRODUCTIVE Footage	TOTAL PRODUCTIVE Avge.	DRY WILDCATS No.	DRY WILDCATS Footage	DRY WILDCATS Avge.	TOTAL WILDCATS No.	TOTAL WILDCATS Footage	TOTAL WILDCATS Avge.
Alabama													10	41,585	4,158	10	41,585	4,158
Alaska	1	11,315	11,315				1	14,020	14,020	2	25,335	12,667	7	61,795	8,828	9	87,130	9,681
Arizona	1	6,997	6,997							1	6,997	6,997	21	37,229	1,773	22	44,226	2,010
Arkansas	3	11,501	3,834	1	11,365	11,365	3	12,921	4,307	7	35,787	5,112	111	420,307	3,786	118	456,094	3,780
California	11	67,802	6,164				11	75,844	6,895	22	143,646	6,529	272	1,414,715	5,201	294	1,558,361	5,300
Colorado	20	109,286	5,464				9	51,724	5,747	29	161,010	5,552	303	1,543,345	5,093	332	1,704,355	5,134
Illinois	10	21,663	2,166				1	1,884	1,884	11	23,547	2,141	616	1,025,752	1,665	627	1,049,299	1,673
Indiana	5	6,148	1,230							5	6,148	1,230	333	406,840	1,222	338	412,988	1,222
Kansas	90	354,204	3,936				24	103,253	4,302	114	457,457	4,013	786	2,968,229	3,776	900	3,425,686	3,806
Kentucky	10	17,503	1,750				2	2,377	1,188	12	19,880	1,657	44	57,721	1,312	56	77,601	1,386
Louisiana	31	272,858	8,802	18	210,252	11,681	8	88,582	11,073	57	571,692	10,030	482	4,164,834	8,641	539	4,736,526	8,788
North Louisiana	15	96,363	6,424				2	13,718	6,859	17	110,081	6,475	220	1,116,559	5,075	237	1,226,640	5,176
South Louisiana	16	176,495	11,030	18	210,252	11,681	6	74,864	12,477	40	461,611	11,540	262	3,048,275	11,635	302	3,509,886	11,622
*Gulf of Mexico				2	22,057	11,028	1	12,512	12,512	3	34,569	11,523	34	438,989	12,911	37	473,558	12,799
Michigan	9	115,299	12,811				3	10,704	3,568	12	126,003	10,500	242	889,392	3,675	254	1,015,395	3,998
Mississippi	20	195,653	9,783				1	14,000	14,000	21	209,653	9,983	229	2,159,065	9,428	250	2,368,718	9,475
Missouri													4	7,888	1,972	4	7,888	1,972
Montana	10	67,852	6,785				4	10,455	2,614	14	78,307	5,593	129	547,551	4,245	143	625,858	4,377
Nebraska	28	155,964	5,570				1	5,143	5,143	29	161,107	5,555	406	2,164,548	5,331	435	2,325,655	5,346
New Mexico	62	385,951	6,225				36	260,625	7,240	98	646,576	6,598	246	1,104,539	4,490	344	1,751,115	5,090
Southeast New Mexico	45	317,614	7,058				11	109,277	9,934	56	426,891	7,623	184	894,962	4,864	240	1,321,853	5,508
Northwest New Mexico	17	68,337	4,020				25	151,348	6,054	42	219,685	5,231	62	209,577	3,380	104	429,262	4,127
North Dakota	7	51,091	7,299							7	51,091	7,299	64	369,286	5,770	71	420,377	5,920
Ohio	3	6,828	2,276				9	38,247	4,250	12	45,075	3,756	41	145,452	3,548	53	190,527	3,595
Oklahoma	53	345,952	6,527	9	73,151	8,128	36	219,308	6,092	98	638,411	6,514	348	1,556,204	4,472	446	2,194,615	4,920
Pennsylvania							8	49,859	6,232	8	49,859	6,232	21	131,272	6,251	29	181,131	6,246
South Dakota													8	33,810	4,226	8	33,810	4,226
Tennessee	3	2,493	831				3	1,695	565	6	4,188	698	51	42,013	825	57	46,201	810
Texas	166	984,325	5,930	42	369,619	8,800	68	440,492	6,478	276	1,794,436	6,502	3,024	16,265,535	5,379	3,300	18,059,971	5,473
Dist. 1: South Central	4	18,764	4,691	1	7,555	7,555	3	10,318	3,439	8	36,637	4,580	314	1,084,992	3,455	322	1,121,629	3,483
Dist. 2: Middle Gulf	8	62,195	7,774	13	117,961	9,074	7	33,942	4,849	28	214,098	7,646	208	1,405,072	6,755	236	1,619,170	6,861
Dist. 3: Upper Gulf	10	102,330	10,233	16	148,482	9,280	5	44,094	8,819	31	294,906	9,513	265	3,821,870	14,422	296	4,116,776	13,908
*Gulf of Mexico													7	73,145	10,449	7	73,145	10,449
Dist. 4: L. Gulf-S.W.	11	58,486	5,317	9	75,365	8,374	16	97,045	6,065	36	230,896	6,414	317	1,768,225	5,578	353	1,999,121	5,663
Dist. 5: East Central	2	28,241	14,120	1	3,604	3,604	4	23,732	5,933	7	55,577	7,940	105	494,284	4,707	112	549,861	4,909
Dist. 6: Northeast	7	54,800	7,829	2	16,652	8,326	5	50,001	10,000	14	121,453	8,675	175	1,009,907	5,771	189	1,131,360	5,986
Dist. 7-B: N. Central	54	200,907	3,721				11	41,152	3,741	65	242,059	3,724	584	1,846,864	3,162	649	2,088,923	3,219
Dist. 7-C: W. Central	17	73,303	4,312				6	48,702	8,117	23	122,005	5,305	205	832,680	4,062	228	954,685	4,187
Dist. 8: West	41	319,792	7,800				6	56,120	9,353	47	375,912	7,998	341	1,978,690	5,803	388	2,354,602	6,068
Dist. 9: North	12	65,507	5,459				1	4,553	4,553	13	70,060	5,389	432	1,450,920	3,359	445	1,520,980	3,418
Dist. 10: Panhandle							4	30,833	7,708	4	30,833	7,708	78	572,031	7,334	82	602,864	7,352
Utah	2	14,166	7,083				9	50,888	5,654	11	65,054	5,914	70	372,440	5,320	81	437,494	5,401
Washington													4	20,916	5,229	4	20,916	5,229
Wyoming	19	125,688	6,615	1	11,265	11,265	9	57,071	6,341	29	194,024	6,690	321	1,788,255	5,571	350	1,982,279	5,664
Other States													29	117,375	4,047	29	117,375	4,047
Total, U.S., 1960	564	3,330,539	5,905	71	675,652	9,516	246	1,509,092	6,135	881	5,515,283	6,260	8,222	39,857,893	4,848	9,103	45,373,176	4,984

*Gulf of Mexico wells included in their respective district totals.

Ratio of U.S. Wildcatting to All Drilling and Proportion of Wildcats Discovering New Fields, by Years, 1937-1959

YEAR	Total New Wells Drilled for Oil or Gas*	TOTAL WILDCATS: Number	TOTAL WILDCATS: Percent of All Wells	Dry Wildcats	PRODUCTIVE WILDCATS: TOTAL Number	TOTAL Percent of All Wildcats	OIL Number	OIL Percent of All Wildcats	GAS & DISTILLATE Number	GAS & DISTILLATE Percent of All Wildcats
1937	32,474	2,182	6.7	1,943	239	11.0	203	9.3	36	1.6
1938	27,764	2,443	8.8	2,179	264	10.8	229	9.4	35	1.4
1939	26,654	2,746	10.3	2,488	258	9.4	224	8.2	34	1.2
1940	29,161	2,982	10.2	2,672	310	10.4	262	8.8	48	1.6
1941	30,149	3,409	11.3	3,047	362	10.6	301	8.8	61	1.8
1942	19,729	3,001	15.2	2,652	349	11.6	288	9.6	61	2.0
1943	18,641	3,298	17.7	2,951	347	10.5	276	8.4	71	2.1
1944	23,733	3,885	16.4	3,425	460	11.8	326	8.4	134	3.4
1945	24,482	3,946	16.1	3,486	460	11.7	317	8.1	143	3.6
1946	28,145	4,242	15.1	3,830	412	9.7	308	7.3	104	2.5
1947	31,084	4,983	16.0	4,407	576	11.6	436	8.8	140	2.8
1948	37,448	6,410	17.1	5,618	792	12.4	610	9.5	182	2.9
1949	37,812	6,781	17.9	5,914	867	12.8	668	9.9	199	2.9
1950	42,173	7,891	18.7	6,876	1,015	12.9	811	10.3	204	2.6
1951	44,571	9,778	21.9	8,552	1,226	12.5	992	10.1	234	2.5
1952	45,275	10,239	22.6	8,972	1,267	12.4	982	9.6	285	2.8
1953	48,242	10,743	22.3	9,325	1,418	13.2	1,062	9.9	356	3.3
1954	51,419	10,821	21.0	9,387	1,434	13.3	1,056	9.8	378	3.5
1955	55,207	11,601	21.0	10,157	1,444	12.4	1,085	9.3	359	3.1
1956	57,390	12,624	22.0	11,186	1,438	11.4	1,070	8.5	368	2.9
1957	52,391	11,409	21.8	10,228	1,181	10.4	848	7.4	333	2.9
1958†	47,761	9,799	20.5	8,750	1,049	10.7	743	7.6	306	3.1
1959†	49,071	9,940	20.3	8,856	1,084	10.9	713	7.2	371	3.7
1960	45,547	9,103	20.0	8,222	881	9.7	564	6.2	317	3.5

*Not including service wells. † Revised to include secondary recovery wells in Eastern Kansas.



Liquid hydrocarbon reserves in U.S. are at new high

DESPITE REDUCED DRILLING since the peak of 1956, there have been good results in developing new reserves of liquid hydrocarbons in the United States. Except in 1957, annual provings of new reserves since World War II have materially exceeded production, though production has been static during the past five years, instead of constantly rising as before.

Estimated Proved Reserves of Crude Oil, Natural Gas Liquids and Total Liquid Hydrocarbons in U.S., by States, at End of 1958 and 1959

(Source: American Petroleum Institute)

THOUSANDS OF BARRELS

STATE	CRUDE OIL		NATURAL GAS LIQUIDS		TOTAL LIQUID HYDROCARBONS	
	End of 1959	End of 1958	End of 1959	End of 1958	End of 1959	End of 1958
Alabama	34,248	38,586			34,248	38,586
Arkansas	312,911	317,865	32,017	34,150	344,928	352,015
*California	3,762,507	3,866,430	325,318	302,319	4,087,825	4,168,749
Colorado	380,952	392,060	24,914	21,268	405,866	413,328
Illinois	594,407	607,589	10,754	10,950	605,161	618,539
Indiana	73,951	71,469	124	119	74,075	71,588
Kansas	917,503	922,434	196,912	199,552	1,114,415	1,121,986
Kentucky	136,324	126,357	49,290	37,472	185,614	163,829
*Louisiana	4,660,088	4,043,993	1,357,798	1,195,955	6,017,886	5,239,948
Michigan	55,335	44,968	1,562	1,502	56,897	46,470
Mississippi	389,337	378,688	40,944	55,182	430,281	433,870
Montana	309,268	337,799	13,511	7,497	322,779	345,296
Nebraska	80,558	69,242	5,432	5,699	85,990	74,941
New Mexico	1,025,789	894,121	423,040	417,238	1,448,829	1,311,359
New York	34,197	35,803			34,197	35,803
North Dakota	381,909	314,079	97,928	31,239	479,837	345,318
Ohio	74,137	70,809	1,304	1,618	75,441	72,427
Oklahoma	1,864,749	1,898,128	367,569	357,507	2,232,318	2,255,635
Pennsylvania	113,574	119,832	3,677	3,685	117,251	123,517
*Texas	14,859,674	14,322,216	3,430,375	3,391,967	18,290,049	17,714,183
Utah	194,539	198,639	32,376	14,899	226,915	213,538
West Virginia	51,259	52,104	34,166	63,286	85,425	115,390
Wyoming	1,402,938	1,408,717	73,279	50,876	1,476,217	1,459,593
†Miscellaneous	9,193	3,989	18	38	9,211	4,027
Total U.S.	31,719,347	30,535,917	6,522,308	6,204,018	38,241,655	36,739,935

* Includes off-shore reserves.
† Miscellaneous includes: Crude in Alaska, Ariz., Fla., Mo., Nev., S.D., Tenn., Va., and Wash.: Natural gas liquids in Ala., Fla., and Mo.

Consequently, the ratio of reserves to annual production has been well maintained. The reserves at the end of 1959 were equivalent to 13.3 years of production at the 1959 rate. In 13 post war years, 1947 through 1959, the ratio of reserves to annual production has ranged from 12.3 to 14.1 and has averaged 13.1. Thus the latest figure is above the average.

At new peak. U.S. reserves of liquid hydrocarbons were at a new record high of 38,241,655,000 barrels at the end of 1959, up 1.5 billion barrels from the end of 1958. That net gain was the result of developing nearly 4.4 billion barrels of new reserves in 1959 while producing 2.9 billion.

The 4.4 billion barrels proved up in 1959 was the greatest amount in any year since World War II, except 5.1 billion in 1951. The 1959 experience was much better than results in either of the four years of heaviest U.S. drilling, from 1954 through 1957.

Drilling situation. The good record for 1959 reflected increased concentration on development rather than exploratory drilling and the limiting of wildcatting primarily to better prospects. Those moves were required because of weak markets and unsatisfactory earnings in the industry and the need to hold down expenditures.

Development drilling is, however, only a secondary stage in maintaining reserves. It proves up oil already tentatively indicated by exploratory drilling. Ultimately, ample exploratory drilling is necessary for consistent maintenance of adequate reserves.

Judging by experience of the past decade, the United States will have to drill over 50,000 wells per year to maintain reserves equivalent to 13 years of production, as heretofore. In the 1950s, 50,250 wells per year were drilled on average, and while production has not varied greatly in the past five years, it has been at higher levels than in the first half of the decade. If U.S. production should be increased above current levels, maintenance of reserves at 13 times annual production probably would require the drilling of well above 50,000 wells per year.

Crude reserves. The 38,241,655,000 barrels of U.S. liquid hydrocarbon re-

serves at the end of 1959 included 31,719,347,000 barrels of crude oil and 6,522,308,000 barrels of natural gas liquids.

The crude reserves were equivalent to 12.8 years' production at the 1959 rate, compared with an average ratio of 12.5 since World War II. Natural gas liquids reserves were equal to 16.9 years of production, against a post war average ratio of 18.0.

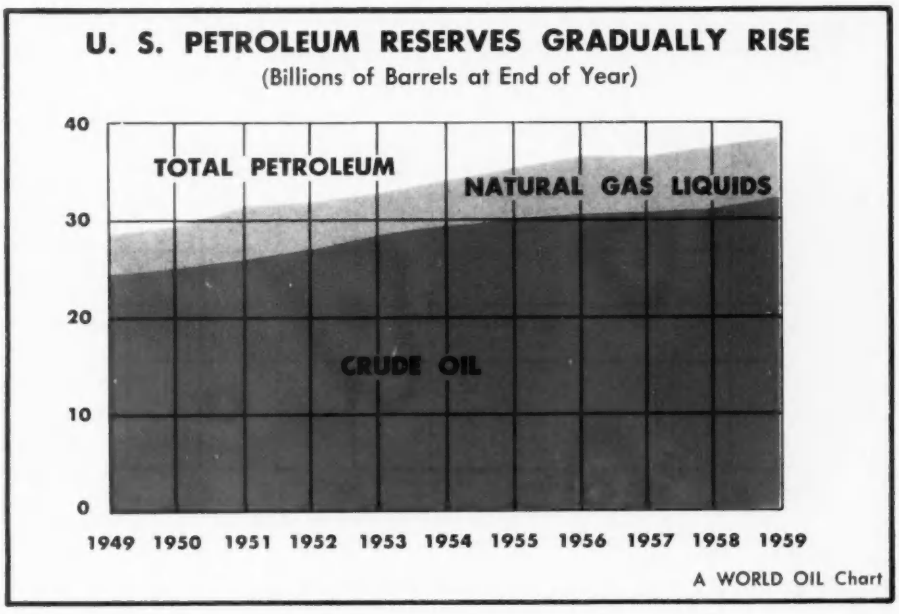
Reserves by states. The net increase of 1.5 billion barrels in U.S. liquid hydrocarbon reserves in 1959 was largely the result of increases in four states, as follows: Louisiana 778 million barrels, Texas 576 million, New Mexico 137 million and North Dakota 135 million. Those four states combined showed an increase of 1.6 billion barrels in reserves during 1959.

All other states combined showed a decrease, though some had increases and others decreases. States with limited gains included Indiana, Kentucky, Michigan, Nebraska, Ohio, Utah, and Wyoming. Those showing decreases in reserves included Alabama, Arkansas, California, Colorado, Illinois, Kansas, Mississippi, Montana, New York, Oklahoma, Pennsylvania and West Virginia.

At the end of 1959, seven states accounted for 34.7 billion barrels or 90.7 percent of the U.S. reserves of liquid hydrocarbons. They were Texas, Louisiana, California, Oklahoma, Wyoming, New Mexico, and Kansas. All other states held 3.6 billion barrels (9.3 percent).

Texas has nearly half. Texas led with 18.3 billion barrels or 47.8 percent of the U.S. total, compared with 17.7 billion (48.2 percent) a year earlier. Louisiana strengthened its No. 2 rank in reserves as well as production, boosting reserves to 6.0 billion barrels (15.7 percent of U.S.), from 5.2 billion (14.3 percent). California's reserves decreased to 4.088 billion barrels (10.7 percent of U.S.) from 4.169 billion (11.3 percent).

Oklahoma at end of 1959 had 2.2 billion barrels of reserves, or 5.8 percent of the U.S. total. Wyoming had 1.476 billion (3.9 percent), New Mexico 1.449 billion (3.8 percent), Kansas 1.1 billion (2.9 percent).

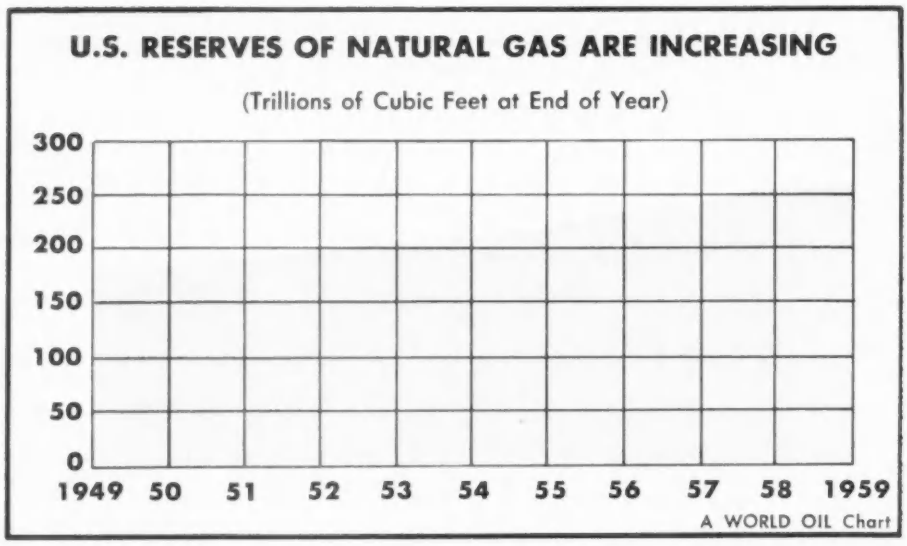


Estimated Proved Reserves of Crude Oil, Natural Gas Liquids, and Total Liquid Hydrocarbons in United States, by Years

(Sources: American Petroleum Institute and American Gas Association.)
Note: For prior years, see WORLD OIL, February 15, 1959, page 160.
(Thousands of Barrels)

Year and Item	CHANGES IN RESERVES DURING YEAR (ADDITION) RESERVES PROVED: Revisions of Prior Estimates	Extensions to Old Pools	Total Revisions and Extensions	New Pools Discovered	Total New Reserves Proved	(Deduct) Production During Year	(Net Change) Increase or Decrease	Estimated Proved Reserves at End of Year	Ratio, Year End Reserves to Year's Prod. (Year's Supply)
Crude Oil									
1945	.....	.....	.....	.....	1,870,971	1,713,655	+ 157,316	19,941,846	11.6
1946	1,254,705	1,158,923	2,413,628	244,434	2,658,062	1,726,348	+ 931,714	20,873,560	12.1
1947	749,278	1,269,862	2,019,140	445,430	2,464,570	1,850,445	+ 614,125	21,487,685	11.6
1948	1,958,853	1,439,873	3,398,726	396,481	3,795,207	2,002,448	+1,792,759	23,280,444	11.6
1949	603,566	1,693,862	2,297,428	890,417	3,187,845	1,818,800	+1,369,045	24,649,489	13.6
1950	663,378	1,334,391	1,997,769	564,916	2,562,685	1,943,776	+ 618,099	25,268,398	13.0
1951	1,776,110	2,248,588	4,024,698	389,256	4,413,954	2,214,321	+2,199,633	27,468,031	12.4
1952	743,729	1,509,131	2,252,860	496,428	2,749,288	2,256,765	+ 492,523	27,960,554	12.4
1953	1,264,832	1,439,618	2,704,450	591,680	3,296,130	2,311,856	+ 984,274	28,944,828	12.5
1954	537,788	1,749,443	2,287,231	585,806	2,873,037	2,257,119	+ 615,918	29,560,746	13.1
1955	696,114	1,697,653	2,393,767	476,957	2,870,724	2,419,300	+ 451,424	30,012,170	12.4
1956	804,803	1,702,211	2,507,114	467,222	2,974,336	2,551,857	+ 422,479	30,434,649	11.9
1957	465,421	1,543,182	2,008,603	416,197	2,424,800	2,559,044	— 134,244	30,300,405	11.8
1958	954,605	1,338,908	2,293,513	314,729	2,608,242	2,372,730	+ 235,512	30,535,917	12.9
1959	1,518,678	1,778,705	3,297,383	369,362	3,666,745	2,483,315	+1,183,430	31,719,347	12.8
Natural Gas Liquids									
1946	.....	.....	.....	.....	.....	.....	.....	3,163,219	.....
1947	.....	.....	192,237	59,301	251,538	160,782	+ 90,756	3,253,975	20.2
1948	.....	.....	405,874	64,683	470,557	183,749	+ 286,808	3,540,783	19.3
1949	.....	.....	294,211	92,565	386,776	198,547	+ 188,229	3,729,012	18.8
1950	.....	.....	707,879	58,183	766,062	227,411	+ 538,651	4,267,663	18.8
1951	.....	.....	648,497	75,494	723,991	267,052	+ 456,939	4,724,602	17.7
1952	.....	.....	475,170	81,668	556,838	284,789	+ 272,049	4,996,651	17.5
1953	.....	.....	648,047	95,922	743,969	302,698	+ 441,271	5,437,922	18.0
1954	.....	.....	20,830	86,520	107,350	300,815	— 193,465	5,244,457	17.4
1955	.....	.....	447,160	67,348	514,508	320,400	+ 194,108	5,438,565	17.0
1956	.....	.....	715,764	94,056	809,820	346,053	+ 463,767	5,902,332	17.1
1957	.....	.....	8,884	128,508	137,392	352,364	— 214,972	5,687,360	16.1
1958	.....	.....	749,956	108,250	858,206	341,548	+ 516,658	6,204,018	18.2
1959	.....	.....	593,905	109,539	703,444	385,154	+ 318,290	6,522,308	16.9
Total Liquid Hydrocarbons									
1946	.....	.....	.....	.....	.....	.....	.....	24,036,779	.....
1947	.....	.....	2,211,377	564,731	2,716,108	2,011,227	+ 704,881	24,741,660	12.3
1948	.....	.....	3,804,600	461,164	4,265,764	2,186,197	+2,079,567	26,821,227	12.3
1949	.....	.....	2,591,639	982,982	3,574,621	2,017,347	+1,557,274	28,378,501	14.1
1950	.....	.....	2,705,648	623,099	3,328,747	2,171,187	+1,157,560	29,536,061	13.6
1951	.....	.....	4,673,195	464,750	5,137,945	2,481,373	+2,656,572	32,192,633	13.0
1952	.....	.....	2,728,030	578,096	3,306,126	2,541,554	+ 764,572	32,957,205	13.0
1953	.....	.....	3,352,497	687,602	4,040,099	2,614,554	+1,425,545	34,382,750	13.2
1954	.....	.....	2,308,061	672,326	2,980,387	2,557,934	+ 422,453	34,805,203	13.6
1955	.....	.....	2,840,927	544,305	3,385,232	2,739,700	+ 645,532	35,450,735	13.0
1956	.....	.....	3,222,878	561,278	3,784,156	2,897,910	+ 886,246	36,336,981	12.5
1957	.....	.....	2,017,487	544,705	2,562,192	2,911,408	— 349,216	35,987,765	12.4
1958	.....	.....	3,043,469	422,979	3,466,448	2,714,278	+ 752,170	36,739,935	13.5
1959	.....	.....	3,891,288	478,901	4,370,189	2,868,469	+1,501,720	38,241,655	13.3

• Production compiled by API and AGA committees on basis of 11 months actual and December estimated. Small variance of these figures from actual production as later reported is compensated by revision when reserves report for succeeding year is complied.



U.S. gas reserves increase despite growing consumption

DEVELOPMENT OF NEW GAS reserves in the United States has continued relatively successful. But since gas consumption steadily grows, gas reserves are shrinking in terms of years' supply at the prevailing rates of production. The record setting 262.6 trillion cubic feet of U.S. natural gas reserves at the end of 1959 were equivalent to 21.1 years' production at the rate recorded in 1959. That was the lowest ratio in the records.

During 1959 new reserves proved up totaled 20.7 trillion cubic feet, compared with 19.0 trillion in 1958, 20.1 trillion in 1957, and a record for recent years of 24.9 trillion feet in 1956, when U.S. drilling also set a record.

After making net additions in 1959, Texas held 45.9 percent of U.S. reserves and Louisiana 22.8 percent. Following decreases in 1959, Kansas held 7.6 percent and New Mexico 6.8 percent. Oklahoma had a net addition and then held 6.3 percent. California lowered its reserves and then held only 3.3 percent of the U.S. total. These six states together held 92.7 percent of U.S. reserves, and all other states combined held 7.3 percent.

U.S. Reserves of Natural Gas, by States, at End of 1959 and 1958
(Source: AGA . . . Millions of Cubic Feet —14.65 psia, at 60 Deg. F.)

State	End of 1959	End of 1958
Arkansas	1,422,817	1,388,337
*California	8,593,447	8,966,522
Colorado	2,496,159	2,349,240
Illinois	175,110	170,528
Indiana	35,088	30,569
Kansas	19,981,403	20,233,847
Kentucky	1,159,381	1,215,329
*Louisiana	59,853,920	55,111,862
Michigan	515,403	498,113
Mississippi	2,486,524	2,598,377
Montana	665,491	682,013
Nebraska	132,719	143,321
New Mexico	17,912,798	21,180,020
New York	106,519	96,439
North Dakota	1,206,542	1,124,470
Ohio	748,766	818,052
Oklahoma	16,651,292	15,206,769
Pennsylvania	1,051,972	870,014
*Texas	120,475,783	115,045,743
Utah	1,264,250	1,058,051
Virginia	38,632	38,421
West Virginia	1,593,551	1,557,633
Wyoming	3,847,064	3,649,818
†Miscellaneous	181,962	108,549
Total, U.S.	262,596,593	254,142,037

* Includes off-shore reserves. † Includes Ala., Ariz., Fla., Iowa, Md., Mo.

Changes in U. S. Reserves of Natural Gas, by Years, Since 1945
Source: AGA . . . Data in millions of cubic feet, 14.65 psi at 60° F.

YEAR	Estimated Proved Reserves Beginning of Year	CHANGES IN RESERVES DURING YEAR: (Add.) Reserves Proved: Extensions and Revisions	Discoveries of New Fields and New Pools in Old Fields	Total Reserves Proved During Year (Cols.2+3)	(Add or Deduct) Net Change in Storage	(Deduct) Net Production During Year	(Net Change) Increase or Decrease (Cols. 4+5—6)	Estimated Proved Reserves End of Year (Cols. 1+7)	Ratio of Year-End Reserves to Year's Prod. (Year's Supply) Col. 8÷Col. 6
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1945								147,789,367	
1946	147,789,367			17,729,152	*	4,942,617	+12,786,535	160,575,901	32.5
1947	160,575,901	7,570,654	3,410,170	10,980,824	*	5,629,811	+ 5,351,013	165,926,914	29.5
1948	165,926,914	9,769,483	4,129,089	13,898,572	+ 51,482	6,007,628	+ 7,942,426	173,869,340	28.9
1949	173,869,340	8,061,429	4,612,870	12,674,299	+ 82,746	6,245,041	+ 6,512,004	180,381,344	28.9
1950	180,381,344	9,172,381	2,877,351	12,049,732	+ 54,301	6,892,678	+ 5,211,355	185,592,699	26.9
1951	185,592,699	13,013,606	3,039,385	16,052,991	+132,751	7,966,941	+ 8,218,801	193,811,500	24.3
1952	193,811,500	8,934,470	5,411,043	14,345,513	+198,850	8,639,638	+ 5,904,725	199,716,225	23.1
1953	199,716,225	13,371,355	7,081,661	20,453,016	+516,431	9,238,540	+11,730,907	211,447,132	22.9
1954	211,447,132	4,632,309	4,966,894	9,599,203	+ 90,906	9,426,509	+ 263,600	211,710,732	22.5
1955	211,710,732	16,298,125	5,719,069	22,017,194	+ 87,637	10,118,118	+11,986,713	223,697,445	22.1
1956	223,697,445	19,214,604	5,636,476	24,851,080	+133,970	10,907,926	+14,077,124	237,774,569	21.7
1957	237,774,569	11,118,319	8,998,993	20,117,312	+179,733	11,502,359	+ 8,794,686	246,569,255	21.4
1958	246,569,255	13,388,808	5,611,098	18,999,906	+ 57,902	11,485,026	+ 7,572,782	254,142,037	22.1
1959	254,142,037	14,933,109	5,800,749	20,733,858	+161,326	12,440,628	+ 8,454,556	262,596,593	21.1

* Not estimated.

Estimates of Proved Reserves of Natural Gas in U. S., by Years, Since 1918
(Production from Bureau of Mines)

YEAR	Reserves End of Year (Billion Cubic Feet)	Authority for Estimate of Reserves	Net Production (Billion Cubic Feet)	Ratio Reserve to Annual Prod.
1918	15,000	E. Holley Poe[1]	721	20.8
1919	15,000	" "	746	20.1
1920	15,000	" "	798	18.8
1921	15,000	" "	662	22.7
1922	15,000	" "	763	19.7
1923	15,000	" "	1,007	14.9
1924	15,000	" "	1,142	13.1
1925	23,000	*Gas Facts*[2]	1,189	19.3
1926	23,000	" "	1,313	17.5
1927	23,000	" "	1,445	15.9
1928	23,000	" "	1,568	14.7
1929	23,000	" "	1,918	12.0
1930	46,000	Earl P. Hines[3]	1,943	23.7
1931	46,000	" "	1,686	27.3
1932	46,000	" "	1,556	29.6
1933	46,000	" "	1,555	29.6
1934	62,000	Ralph E. Davis[4]	1,771	35.0
1935	62,000	" "	2,408	25.7
1936	62,000	" "	2,571	24.1
1937	66,000	" "	2,854	23.1
1938	70,000	Lyon F. Terry[5]	2,960	23.6
1939	70,000	" "	3,162	22.1
1940	85,000	Ralph E. Davis[4]	3,331	25.5
1941	113,800	P.A.W.[6]	3,459	32.9
1942	110,000	"	3,701	29.7
1943	110,000	"	4,336	25.4
1944	133,500	"	4,731	28.2
1945	147,789	A.G.A.[7]	4,840	30.5
1946	160,576	"	4,943	32.5
1947	165,927	"	5,630	29.5
1948	173,869	"	6,008	28.9
1949	180,381	"	6,245	28.9
1950	185,593	"	6,893	26.9
1951	193,811	A.G.A.[7]	7,967	24.3
1952	199,716	"	8,640	23.1
1953	211,447	"	9,239	22.9
1954	211,711	"	9,427	22.5
1955	223,697	"	10,118	22.1
1956	237,775	A.G.A.[7]	10,908	21.7
1957	246,569	"	11,502	21.4
1958	254,142	"	11,485	22.1
1959	262,597	"	12,441	21.1

[1] And Associates, New York, in report September 30, 1947. [2] American Gas Association yearbook, 1945 and 1946. [3] Then with Cities Service Co., New York. [4] Consulting Engineer, Houston. [5] Formerly of Chase National Bank, New York. [6] Petroleum Administration for War. [7] American Gas Association.

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Photograph courtesy The Ohio Oil Co.

Winter drilling operations at Ohio Oil's Violet Grove Crown 33-16, Pembina field, Alta., Canada. The North Saskatchewan River can be seen in background.

Decrease in drilling foreseen for Western Canada in 1961

CANADA'S LONG-RANGE outlook for drilling activity is encouraging. The country's export picture improved in January when Shell Oil Company placed a supplementary nomination for 19,000 bpd of Alberta crude to be used as line fill in the Trans Mountain pipe line. With huge new natural gas markets on the horizon, a significant boom in export sales is shaping up over the next five years.

Even so, these promising developments are not expected to curb Canada's ability to produce more crude and gas than markets can absorb during 1961. Drilling activity in Western Canada will remain about the same as 1960.

WORLD OIL forecasts the drilling of 2,425 wells this year, down 12 wells or 0.5 percent from 1960. Footage drilled is expected to total 13,216,250 feet, down 137,886 feet, or 1 percent.

This will reflect slight decreases in Alberta and Saskatchewan, partially offset by an increase in British Columbia. Other areas are expected to remain about the same.

Early indications are that 1961 will be an active year for natural gas, with the crude oil picture clouded with many uncertainties. One of the big factors in Canada's oil future is the current lack of a formal national oil policy for either voluntary or compulsory expansion of markets for Canadian crude.

However, Prime Minister John Diefenbaker has been made well aware of Canada's oil problems by the National Energy Board and others. New moves to make greater use of existing transport facilities to market areas where Canadian oil now reaches, or, if necessary, to Canadian markets now being supplied by overseas petroleum, can provide the biggest single boost to 1961 Canadian drilling activity.

Canada's well completion record has declined steadily in the past four years, dropping from 2,993 wells completed in 1957, to 2,588 in 1958, 2,456 in 1959, and last year's 2,437 wells. Footage drilled dropped more than 1 million feet during the 1957-1958 period, from 13,868,509 feet to 12,949,373 feet. Another drop of more than 300,000 feet was reported in 1959, with a total of 12,608,460 feet. However, the footage total increased nearly 750,000 feet, to 13,354,136 feet in 1959.

Forecast of Wells and Footage to Be Drilled in Western Canada in 1961

YEAR	Wells	Footage
1961 Forecast	2,425	13,216,250
Difference	—12	—137,886
Percent Difference	—0.5	—1.0
1960	2,437	13,354,136
1959	2,456	12,608,460
1958	2,588	12,949,373
1957	2,993	13,968,509

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The present major development in North Africa was spurred by discovery of oil at Hassi Messaoud in the Sahara Desert in Algeria. The discovery well, SN REPAL's MD-1, shown here, was spudded in April 1954. Drilled to 11,500 feet, it penetrated 459 feet of oil-saturated Cambrian sandstone below 10,922 feet. It was completed for 931 barrels of 45 gravity oil daily on a 21/64 inch choke.

Drilling rise due in Free World outside U.S.-Canada

DRILLING in the Free World outside of the United States and Canada is expected to increase by almost seven percent to more than 6,000 completions this year. A total of 6,081 new wells is forecast in 1961, an increase of 6.6 percent compared to the 5,702 completions tabulated, partly by estimates, in 1960. There were 5,043 new wells finished in the Free World outside of the U.S. and Canada in 1959.

Hence, this region is undergoing steady growth in drilling activity. This trend is expected to continue in the foreseeable future.

In South America, Argentina is far and away the most active drilling country. About 1,000 new wells were completed in 1960, and more than 1,300 are expected to be completed in 1961 to account for much of the advance in the Free World outside the U.S. and Canada. If new contracts are let in Argentina this year, this forecast should prove to be conservative. In Venezuela, the drilling decline is tapering off. A total of 400 completions is expected in 1961, compared to 430 in 1960, and 707 in 1959.

Slightly fewer completions are expected this year in the Middle East due to the crude oil oversupply situation and remoteness from markets, and also in Western Europe, for several different reasons. Relaxation of duties on imported crudes in West Germany may slacken drilling there; in the Paris Basin, early salt water encroachment in some fields may dampen drilling rates.

Africa's drilling boom should continue to expand this year, with more than 700 new wells expected in 1961. Almost 40 rigs were drilling in Libya at the end of December, and as many as 200 completions may be expected in 1961 since the preliminary exploration phase has been completed by some companies, and development drilling augments the brisk wildcatting pace.

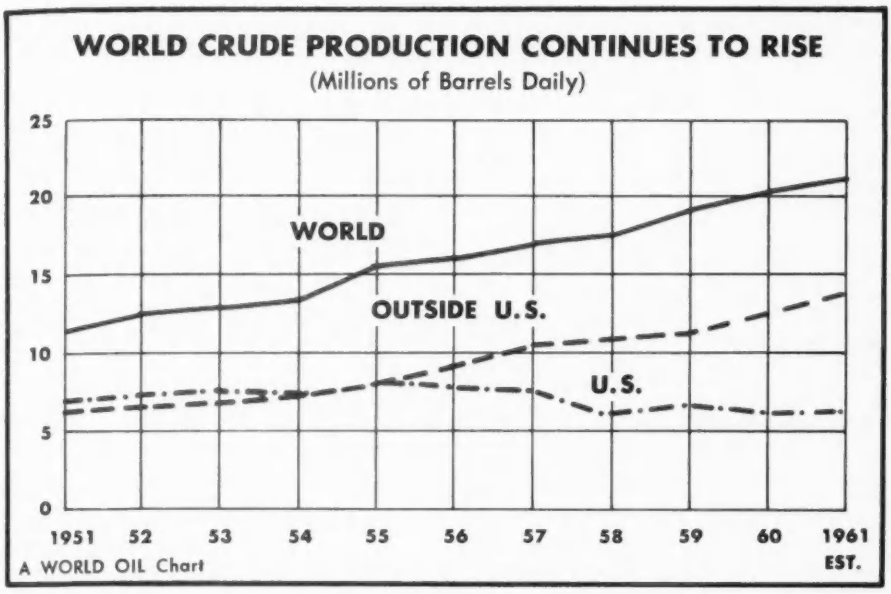
In the Far East, drilling rates should remain about status quo, except that the Indian government expects to drill as many as 65 wells in 1961, most of them apparently in the new Cambay oil province in western India.

1961 Drilling Prospects for Free World Outside U.S. and Canada

(U.S.S.R and Soviet satellite countries not included.)

Region	Wells Forecast 1961	WELLS DRILLED *1960	WELLS DRILLED 1959
Mexico	**675**	**665**	**441**
Central America	**6**	**7**	**7**
West Indies	**315**	**305**	**293**
South America	**2,510**	**2,150**	**1,949**
Argentina	1,350	1,000	577
Brazil	240	240	229
Chile	70	56	90
Colombia	240	220	219
Venezuela	400	430	707
Others	210	204	127
Western Europe	**975**	**1,030**	**1,100**
Austria	95	100	82
France	180	200	201
Italy-Sicily	180	200	206
West Germany	420	440	508
Others	100	90	103
Africa	**710**	**650**	**405**
Algeria	175	170	149
Other Africa	535	480	256
Middle East	**190**	**215**	**217**
Asia, Far East	**500**	**460**	**388**
Japan	375	375	317
Others	125	85	71
Oceania	**200**	**220**	**243**
Indonesia	130	140	142
Others	70	80	101
Total	**6,081**	**5,702**	**5,043**

* Not including wells suspended; 1960 completions partially estimated in some areas.



World crude production to climb again in 1961

WORLD CRUDE OIL production is expected to reach or exceed 22 million barrels daily this year, thus maintaining about the same rate of growth as in 1960. The estimated output of 22,051,000 bpd in 1961 would represent an increase of 1,159,279 bpd or 5.5 percent over the 1960 average of 20,891,721 bpd. The 1960 rate was 1,411,506 bpd or 7.2 percent higher than that of 19,480,215 bpd in 1959.

United States crude yield is expected to increase by about 2.7 percent this year; production outside the U.S. should increase by about 7 percent. Whereas U.S. production represented 36.2 percent of the world total in 1959 and 33.6 percent in 1960, the proportion will probably drop further to about 32.7 percent in 1961.

Estimated crude oil yield in Russia last year was 2.9 million bpd, a 15.1 percent increase over 1959. The Soviet Union has probably passed the three million barrels daily rate by now.

Important gains are being made in Algeria. Hassi-Messaoud field was on full production last year, and the new 24-inch pipe line from the Polignac Basin fields to the Tunisian coast was completed in October to boost output further.

Crude oil yield continues to mount in the Middle East, despite new competition from North African crudes. Kuwait, Saudi Arabia, Iran, and Iraq all made important gains in output last year. Production from the new Khafji field in the Neutral Zone is expected to begin this year.

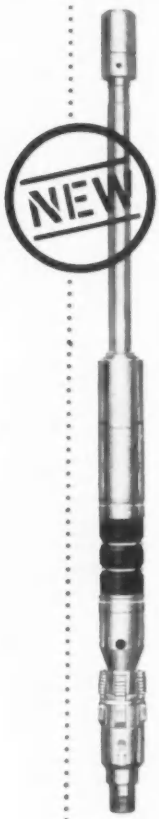
Crude Oil Production of World, U.S., and Countries Outside U.S., by Years
(Source. Private sources except prior to 1957 from U.S. Bureau of Mines)
(THOUSANDS OF BARRELS)

Year	WORLD		U.S.		OUTSIDE U.S.	
	Total	Daily	Total	Daily	Total	Daily
1945	2,594,697	7,109	1,173,665	4,695	881,042	2,414
1946	2,745,430	7,522	1,733,939	4,751	1,011,491	2,771
1947	3,022,139	8,280	1,856,987	5,088	1,165,152	3,192
1948	3,433,234	9,380	2,020,185	5,520	1,413,049	3,861
1949	3,404,132	9,326	1,841,940	5,046	1,562,192	4,280
1950	3,802,955	10,419	1,973,574	5,407	1,829,421	5,012
1951	4,282,730	11,734	2,247,711	6,158	2,035,019	5,576
1952	4,504,708	12,308	2,289,836	6,256	2,214,872	6,052
1953	4,786,989	13,115	2,357,082	6,458	2,429,907	6,657
1954	5,006,205	13,716	2,314,988	6,342	2,691,217	7,374
1955	5,641,439	15,456	2,484,428	6,807	3,157,011	8,649
1956	6,101,967	16,672	2,617,283	7,151	3,484,684	9,521
1957	6,429,712	17,616	2,616,901	7,170	3,812,811	10,446
1958	6,567,935	17,994	2,448,987	6,709	4,118,948	11,285
1959	7,110,279	19,480	2,574,590	7,054	4,535,689	12,426
1960	7,646,370	20,892	2,569,914	7,022	5,076,456	13,870
1961 Est..	8,048,615	22,051	2,631,650	7,210	5,416,965	14,841

World Crude Oil Production, by Countries, 1960 and 1959
(Sources: Private sources or estimates by WORLD OIL and U.S. Bureau of Mines)

Continent and Country	Bbls. Daily			Thous. Bbls.	
	1960	1959	% Diff.	1960	1959
North America	**7,854,290**	**7,823,974**	**0.4**	**2,874,670**	**2,855,751**
Canada	535,519	506,213	5.8	196,000	184,768
Mexico	297,148	264,090	12.5	108,756	96,393
United States	7,021,623	7,053,671	— 0.5	2,569,914	2,574,590
West Indies	**115,751**	**112,640**	**2.8**	**42,365**	**41,114**
Barbados	.....	.....	.....	.....	.....
Cuba	314	534	—41.2	115	195
Trinidad	115,437	112,106	3.0	42,250	40,919
South America	**3,337,235**	**3,196,983**	**4.4**	**1,221,428**	**1,166,899**
Argentina	176,000	132,113	33.2	64,416	48,221
Bolivia	8,807	8,685	1.4	3,223	3,170
Brazil	76,000	64,486	17.9	27,816	23,538
Chile	19,757	17,611	12.2	7,231	6,428
Colombia	155,000	146,778	5.6	56,730	53,574
Ecuador	7,660	7,734	— 1.0	2,804	2,823
Peru	52,481	48,564	8.0	19,208	17,726
Venezuela	2,841,530	2,771,012	2.5	1,040,000	1,011,419
Western Europe	**263,238**	**244,192**	**7.8**	**96,345**	**89,130**
Austria	45,355	46,427	— 2.3	16,600	16,946
France	38,593	32,090	20.3	14,125	11,713
Germany, West	106,011	99,259	6.8	38,800	36,230
Italy	2,000	1,801	11.0	732	657
Sicily	33,410	29,328	13.9	12,228	10,705
Netherlands	36,120	33,566	7.6	13,220	12,251
United Kingdom	1,749	1,721	1.6	640	628
Eastern Europe	**3,201,702**	**2,804,007**	**10.5**	**1,171,823**	**1,023,463**
Albania	10,000	8,770	14.0	3,660	3,201
Bulgaria	5,000	3,435	45.6	1,830	1,254
Czechoslovakia	2,101	2,285	— 8.1	769	834
Germany, East	.....	.....	.....	.....	.....
Hungary	19,000	21,657	—12.3	6,954	7,905
Poland	3,601	3,555	1.3	1,318	1,298
Rumania	250,000	233,829	6.9	91,500	85,347
U.S.S.R. (Russia)	2,900,000	2,519,000	15.1	1,061,400	919,435
Yugoslavia	12,000	11,476	4.6	4,392	4,189

Continent and Country	Bbls. Daily			Thous. Bbls.	
	1960	1959	% Diff.	1960	1959
Africa, Northern	**228,989**	**85,504**	**167.8**	**83,810**	**31,209**
Algeria	160,000	25,180	535.4	58,560	9,191
Egypt	67,016	58,372	14.8	24,528	21,306
Libya	.....	.....	.....	.....	.....
Morocco	1,973	1,952	1.1	722	712
Africa, Southwest	**35,262**	**27,047**	**30.4**	**12,906**	**9,872**
Angola	1,396	981	42.3	511	358
Gabon	15,634	15,148	3.2	5,722	5,529
Congo	1,060	.....	.....	388	.....
Nigeria	17,172	10,918	57.3	6,285	3,985
Asia, Middle East	**5,275,811**	**4,601,297**	**14.7**	**1,930,947**	**1,679,473**
Bahrain	45,082	45,132	0.1	16,500	16,473
Iran	1,052,399	928,246	13.4	385,178	338,810
Iraq	972,000	852,907	14.0	355,752	311,311
Israel	2,557	2,500	2.3	936	913
Kuwait	1,641,951	1,383,165	18.7	600,954	504,855
Neutral Zone	133,000	116,270	14.4	48,678	42,438
Qatar	174,612	170,403	2.5	63,908	62,197
Saudi Arabia	1,247,139	1,095,399	13.9	456,453	399,821
Turkey	7,071	7,275	— 2.8	2,588	2,655
Asia, Far East	**70,189**	**94,186**	**—25.5**	**25,689**	**34,378**
Burma	10,587	10,664	— 0.7	3,875	3,892
India	8,497	9,720	—12.6	3,110	3,548
Pakistan	5,891	5,736	2.7	2,156	2,094
China	35,000	60,000	—41.7	12,810	21,900
Japan	10,181	7,825	30.1	3,726	2,856
Sakhalin	.....	.....	.....	.....	.....
Taiwan (Formosa)	33	36	— 8.3	12	13
Thailand	.....	205	.....	.....	75
Oceania	**509,254**	**490,385**	**3.8**	**186,387**	**178,990**
Australia	.....	.....	.....	.....	.....
Indonesia	409,836	376,036	9.0	150,000	137,253
New Zealand	.....	12	.....	.....	4
Sarawak-Brunei (Br. Borneo)	95,218	109,786	—13.3	34,850	40,072
West New Guinea	4,200	4,551	— 7.7	1,537	1,661
Total, World	**20,891,721**	**19,480,215**	**7.2**	**7,646,370**	**7,110,279**



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Write for Bulletin 385. Baker Oil Tools, Inc. P.O. Box 2274, Terminal Annex, Los Angeles 54, California

*9 Modern Production Packers

These are

Packer Accessories? Baker offers a complete line that makes the packers more usable and adaptable. Dual and triple string flow tubes, for instance, and plugs and other accessories.

BAKER MODEL "D" RETAINER PRODUCTION PACKER

Product No. 415-D

The most widely used drillable packer in the world. Contains continuous sealing bore and flapper-type back-pressure valve.

BAKER MODEL "DA" RETAINER PRODUCTION PACKER

Product No. 415-DA

Direct variation of Model "D" with a larger I.D. sealing bore located in the upper end of the packer. Permits larger bore through packer accessories. Used as an upper packer in two-packer flowing or pumping, parallel string hookups.

Single-Zone? Multiple-Zone? Water-Flooding? Deep Wells? Shallow? High Temperatures? Formidable Pressures? ■ The nine packers pictured here handle an impressive array of tough and simple production jobs.

* If you count the pictures, you come to number 9. But that's certainly not the total of packers made by Baker. For instance, Models "J" & "K" Snap-Set Packers are also made in double-grip versions. Model "E" is also offered with integral one-shot unloader, or with unloader and hold-down. Moreover, thanks to Baker's continuing program of packer research and development, new packers that will supplement the packers pictured above are coming.

Drillable

BAKER MODEL "F" RETAINER PRODUCTION PACKER

Product No. 415-F

Related design to Model "D". Contains larger continuous bore than Model "D" Used where extra large bore is required in some parallel (triple) string, flowing or pumping hookups.

BAKER MODEL "FA" RETAINER PRODUCTION PACKER

Product No. 415-FA

Related to the Model "F" Packer in the same manner that the Model "DA" is to Model "D". Contains extra large upper sealing bore. Provides largest I.D. of any retainer-type packer. Used in multiple string hookups exclusively.

These are Retrievable

BAKER MODELS "J" AND "K" SNAP-SET DUAL PACKERS

Used as the upper retrievable packers in two or three-packer, parallel-string installations. Provides largest full-opening bores possible. For instance, 7" size has full opening for two 2⅜" tubing strings. Actuated by set-down weight only, and can be set and released as many times as required. Short string can be run and retrieved separately. Model "J" is long-string set; Model "K" is short-string set. Also available are Double-Grip versions that contain built-in, button-type, hydraulic hold-downs.

(left)
Model "J" Single-Grip Snap-Set Dual Packer
Product No. 756-J

(right)
Model "K" Single-Grip Snap-Set Dual Packer
Product No. 756-K

BAKER MODEL "M" SNAP-SET PACKERS

Product No. 635-M

Used as the upper retrievable packer in two-packer, full-opening, selective cross-over, tubing and annulus production hookups. Set with set-down weight. Released and recocked for repeat setting by picking up on tubing.

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Product No. 739-A

One of the shortest, most modern high-performance tension packers. Ideal for economical, low- or high-pressure water flooding. Rugged enough for many high-pressure fracturing and acidizing operations. Simple J-Slot setting mechanism.

BAKER MODEL "E" RETRIEVABLE CASING PACKER

Product No. 420-E

One of the shortest, most compact, set down retrievable packers available. Ideal for light or medium duty production requirements, or for all-around water flooding use. Simple J-Slot setting mechanism.

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Your industry at work

A monthly roundup of items of interest about people, companies and associations

Signal Oil's Private Parking Lot

Helicopter approaches first private rooftop helistop in Los Angeles. The new landing facility is atop Signal Oil and Gas Company's recently completed 16-story building on Wilshire Boulevard.

Standard of California To Merge 4 Subsidiaries

Standard Oil Company of California has announced plans to merge the properties of four subsidiary companies operating from the Rocky Mountains eastward into a single corporate organization to be known as California Oil Company.

Constituents of the merged firm will be the Standard Oil Company of Texas, Houston; California Oil Company, Perth Amboy, New Jersey; Salt Lake Refining Company, Salt Lake City, and The California Company, New Orleans.

The most significant change involved in the consolidation will occur through the formation of California Oil Company, Western Division. With headquarters at Denver, this division will direct marketing, exploration, production and related activities in the Rocky Mountain area and certain Plains states. It will also manage refineries at El Paso and Salt Lake City and marketing in Utah, Southern Idaho, Texas and New Mexico.

F. C. Loomis, a former vice president of Standard of California, Western Operations, Inc., will be president of the Western Division. C. M. Tuller, a former vice president of The California Company, will be vice president and general manager of marketing and supply.

Other officers will include M. P. Paret, Jr., vice president-El Paso; P. N. Johnson, vice president-Salt Lake City; J. H. Todd, vice president-Exploration, Production-Denver, and Dee Davis, vice president, secretary and treasurer-Denver.

Breuer & Curran Oil Merges With Alco Oil and Gas Corp.

Merger of Breuer & Curran Oil Co. and Alco Oil and Gas Corporation, has been announced by G. W. Breuer and M. C. Hoffman, presidents of the respective companies. Operations will be combined under the Alco Oil and Gas Corporation name and all personnel of Breuer & Curran will continue with Alco. G. W. Breuer will be executive vice president in charge of exploration and production.

The merger of resources and personnel

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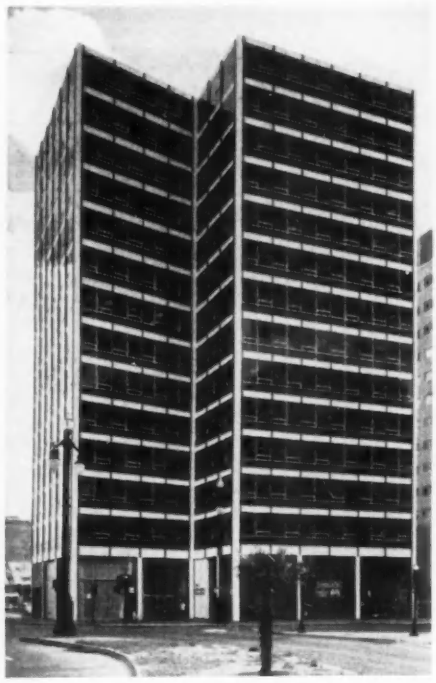

Oil, Gas Industry in New Orleans

This New Orleans Oil and Gas Building, recently completed, rises 14 stories on the city's skyline and reflects the importance of the oil and gas industry in the city's economy.

will lead to wider operations and an expanded exploration syndicate program, according to Arthur C. Allyn, Jr., Alco vice president. The merged company will be operating more than 150 wells and will have in excess of 23 million acres, domestic and foreign, under leasehold or concession. Exploration will be conducted in the Gulf Coast, Mid-Continent, Rocky Mountains and West Coast areas of the United States and in some foreign countries.

Tennessee-Texan Oil Acquires Renwar Oil Corp. Assets

Tennessee-Texan Oil Company, newly organized subsidiary of Tennessee Gas Transmission Company, has acquired the assets of Renwar Oil Corporation in exchange for 800,000 shares of Tennessee Gas Common Stock.

Included in the transaction were leasehold, royalty and fee interests in 27,750 net oil and gas producing acres and 360,659 net undeveloped acres, along with a natural gas dehydration plant and minority interests in two natural gasoline plants. Also among the assets acquired was $3,500,000 in cash.

There are 721 gross or 192 net oil and gas wells located on the producing acreage. Recent net daily average production from these wells was approximately 2,200 barrels of oil and 27,900,000 cubic feet of natural gas.

Production is principally from wells

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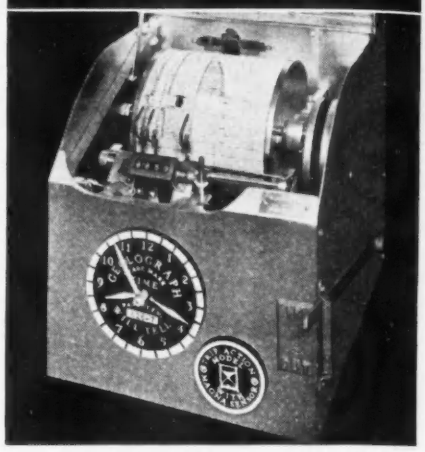

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in South Texas, with additional producing properties in Louisana, Oklahoma, Illinois, and western Canada. Other areas in which interests were acquired include Alaska, Michigan, Ohio, Spain and Guatemala. The wholly owned dehydration plant is at Mustang Island, near Corpus Christi, and the two gasoline plants are in Kleberg and Nueces counties, in Texas.

Tennessee-Texan Oil Co. has been assigned for operational purposes to Tennessee Gas and Oil Company, the domestic and Canadian producing and exploration division of Tennessee Gas Transmission Company headed by Ralph C. Graham, president.

Renwar maintained offices in Dallas and Corpus Christi, with Roland S. Bond, president, and D. W. Forbes, secretary-treasurer, both of Dallas, and Guy I. Warren, vice president and general manager, Corpus Christi, as its only stockholders.

Riffe Petroleum Company Acquired by Wilshire Oil

Wilshire Oil Company of Texas, a Delaware Corporation and a wholly owned subsidiary of Britalta Petroleums Limited, which previously owned 20 percent of the outstanding stock of Riffe Petroleum Company of Tulsa, recently negotiated with the remaining stockholders of Riffe which resulted in Riffe being merged into Wilshire. The merger became effective January 1.

Riffe, a marketer and distributor of asphalt, LP gas and related petroleum products in some 20 states in the south and midwest sections of the United States, will now be operated as a division of Wilshire.

The merger was accomplished through the exchange by Wilshire of a newly created 50 percent convertible preferred stock, convertible into capital shares of the parent company, which have been acquired by Wilshire through purchases in the open market, for the remaining outstanding shares of Riffe.

L. E. Riffe, founder and president of the company, continues as its president and together with other key employes of Riffe, will be retained under long-term employment contracts. Also, on the merger date, Riffe was to become vice president of Wilshire Oil.

As of October 31, 1960, the unaudited balance sheet of Riffe Petroleum reflected assets with a book value of $1,468,022, and a net worth of $259,272. Gross sales of the company for the first seven months ended October 31, of its current fiscal year, were $4,850,044 and its net earnings before taxes for the same period were $221,636.

University of California Offers Aid-to-Engineers

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Further information and application for enrollment may be obtained from the Department of Correspondence Instruction, University Extension, University of California, Berkeley 4, Calif.

Producing Properties Gains Interest in California Wells

Robert J. Bradley, board chairman and chief executive officer of Producing Properties, Inc., has announced that PPI has participated in the acquisition of interests in 47 gas wells in the River Island, East River Island and Isleton fields of Sacramento and San Joaquin counties, California.

According to Producing Properties' engineers, the interests acquired from the seller, Vistario Corp., are estimated to have gas reserves of 14,720,000 Mcf. Bradley said that Vistario received $1,650,000 for their interest in the properties.

This was PPI's seventh California purchase during the past 16 months. Through the six previous purchases, the company acquired working interests in 304 wells under 86 leases with gross daily production of approximately 2,600 barrels from 16 fields.

University of Tulsa To Abstract Literature

The University of Tulsa has announced that beginning January 1, it will operate a service engaging in the abstracting of technical literature and patents covering oil exploration and production. The service will be housed in the Sidney Born Technical Library on the University's North Campus in Tulsa. A skilled staff will abstract articles and patents in the field of geology, geophysics, chemistry and engineering.

Information abstracts will be selected annually from some 500 American, European, Russian and Japanese sources, including 7,000 to 9,000 articles and 1,500 to 2,000 U.S. and foreign patents. The service will publish a weekly bulletin with these abstracts included. Information on charges for this service can be obtained from Dr. E. T. Guerrero, Head, Petroleum Engineering Department, University of Tulsa.

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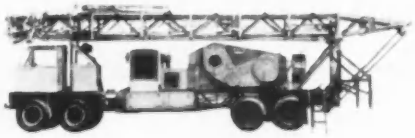

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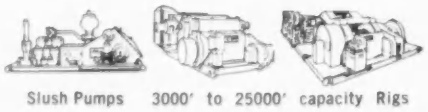

Slush Pumps 3000' to 25000' capacity Rigs

Men in the industry

Ammco Changes Name to Wacker Oil Company

Harry Terrell (left), president of Wacker Oil Company, and Charles H. Wacker, III, chairman of the board, jointly announced a change in their company's corporate identity and the establishment of company headquarters in New Orleans. Formerly known as Ammco Oil Company, the Wacker Oil Company recently moved its offices from Houston to New Orleans.

Grady D. Harris, Jr., and **A. T. F. Seale** have been newly elected to the board of directors of **Kerr-McGee Oil Industries, Inc.** Harris is president of the Fidelity National Bank and Trust Company, Oklahoma City. Seale is vice president-operations of Kerr-McGee. Re-elected directors are: **Breene M. Kerr, Robert S. Kerr, Robert S. Kerr, Jr., T. M. Kerr, F. C. Love, D. A. McGee, J. B. Saunders** and **James E. Webb,** all of Oklahoma City; **J. D. Blosser, Guy C. Kiddoo, Frederick W. Straus** and **Dean Terrill,** all of Chicago; **Edwin L. Kennedy,** New York, and **J. H. Lollar, Jr.,** Houston.

E. K. Lucas has been appointed chief geologist for the **Fain-Porter Drilling Corporation.** With Fain-Porter for two years, Lucas had been with Gulf Oil Corporation.

Marlin P. Nelson has been appointed assistant director of the Advanced Management and Methods Division at **Sun Oil Company.** In his new post, Nelson will work directly with **John F. Harron** who succeeded **Paul D. Barton,** retired.

A. W. Lang, Jr., has been named district production superintendent at Hobbs, N. M., for **Tennessee Gas and Oil Company,** a division of **Tennessee Gas Transmission Company.** Lang was formerly division petroleum engineer for the company at Oklahoma City. Also, **H. W. Swan,** transferred as production foreman from Hobbs to Shreveport, La. He replaces **M. H. Dunehoo** who transferred to Lafayette, La., as production foreman.

A. G. G. De Chastelain

F. J. Jobst

A. G. G. De Chastelain, Calgary, Alta., has been named vice president of **AIRDRILL International, Air/Gas Drilling Consultants. Fred J. Jobst,** vice president of Val R. Wittich, Inc., has been named contact representative for New York for AIRDRILL. De Chastelain will remain based in Calgary where he is vice president and general manager of **Wellsite Air Services, Ltd.**

Installed on caustic lines in 1930, these Rockwell-Nordstrom lubricated plug valves needed only cleaning before installation in new plant.

THE VALVES THAT WOULDN'T RETIRE

The Rockwell-Nordstrom lubricated plug valves shown above were two of dozens installed in 1930 on caustic lines at a process plant. When the plant was torn down in 1959, the valves were still in such good condition that they're being used on the same service in the new plant.

The above story is just one more example of the ruggedness of Rockwell-Nordstrom valves. Since they're sealed positively against leakage by pressurized lubricant and there are no exposed metal-to-metal seats, you get positive shut-off year after year. And, lubrication is preventive maintenance against the high cost of repairs, replacement and downtime. To get complete details on Rockwell-Nordstrom, the original and world's most complete line of lubricated plug valves, lubricants and accessories, write: *Rockwell Manufacturing Company, Pittsburgh 8, Pa.; Canadian Valve Licensee: Peacock Brothers Limited, Montreal, Quebec; Rockwell International S.A., Geneva, Switzerland.*

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Wireline Engineers, S. A.
CASPER, WYOMING—C. A. White.....3-5264
CORPUS CHRISTI, TEXAS—Tolle, Inc....TE 5-5367
CORPUS CHRISTI, TEXAS
J. D. Ball Wire Line Service Co.....TU 3-7762
FARMINGTON, NEW MEXICO
B & R Service, Inc.....DA 5-2393
FORT MORGAN, COLORADO—C. A. White.....919
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Horne Well Service Co.....3-5396
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Men in the industry

Belgian Honor Conferred on Jersey Vice President

In a recent ceremony held in the offices of Esso Belgium, S.A., in Antwerp, the Belgian Minister of Energy, R. de Looze (center), decorated William R. Stott (left), vice president and director of Standard Oil Company (New Jersey) with the Cross of Knight of the Order of Leopold. The award was bestowed on Scott by Belgian's King Baudouin. At right is R. Anderson, president of Esso Belgium.

Donald R. Bergmann has been appointed executive vice president in charge of exploration for **Dakota International Petroleum, Inc.**

Fontaine Martin has been appointed associate general counsel of **Mobil International Oil Company.** Also, **George A. Seymour,** chief pipe line engineer of Mobil International's Producing Department, has been transferred to **Mobil Oil Company de Venezuela.**

Buford W. Max has been named general attorney for **Texaco Inc.** Max succeeds the retired **J. A. Tucker.** In his new capacity, Max will be in charge of Texaco's Legal Department activities in 10 western states.

Edward P. Fleischer has been elected a director of **Southern California Petroleum Corporation.**

E. L. Petree, district production manager at Oklahoma City, has been named production coordinator for **Gulf Oil Corporation's** Domestic Production Operations headquarters in Houston. Petree will report directly to **H. F. Beardmore** who was recently elected a vice president of Gulf and placed in charge of Domestic production operations.

Benjamin H. Weil of Wells Lane, Warren Township, Plainfield, has been named head of a section in the technical information division of **Esso Research and Engineering Company.** Also, **Dr. Elroy J. Inchalik** of Cranford, has been awarded a new post in the chemicals research division of Esso Research and Engineering Co.

Philip S. Justice, manager of **Sun Oil Company's** Rocky Mountain Division, has been appointed to a newly-created post of special assistant to **Jno. G. Pew,** senior vice president in charge of production. Also, **William W. Walmsley** has been named to succeed Justice in the Rocky Mountain Division for Sun Oil.

Robert W. Haigh has become the director of planning for the **Standard Oil Company (Ohio),** with offices and headquarters in Cleveland.

Dr. Peter T. Flawn has been named director of the Bureau of Economic Geology and professor of Geology at **The University of Texas.** He succeeds the late **John T. Lonsdale** as State Geologist.

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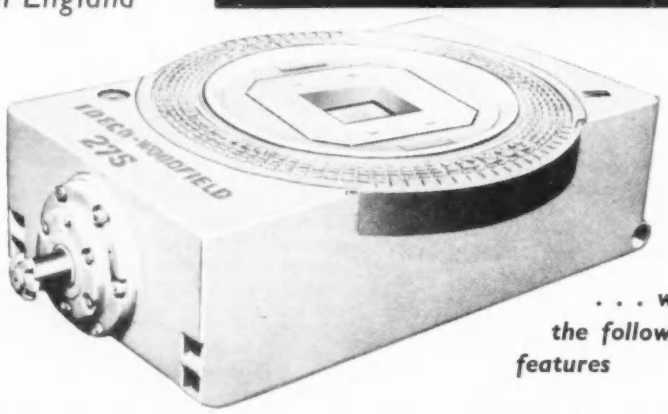

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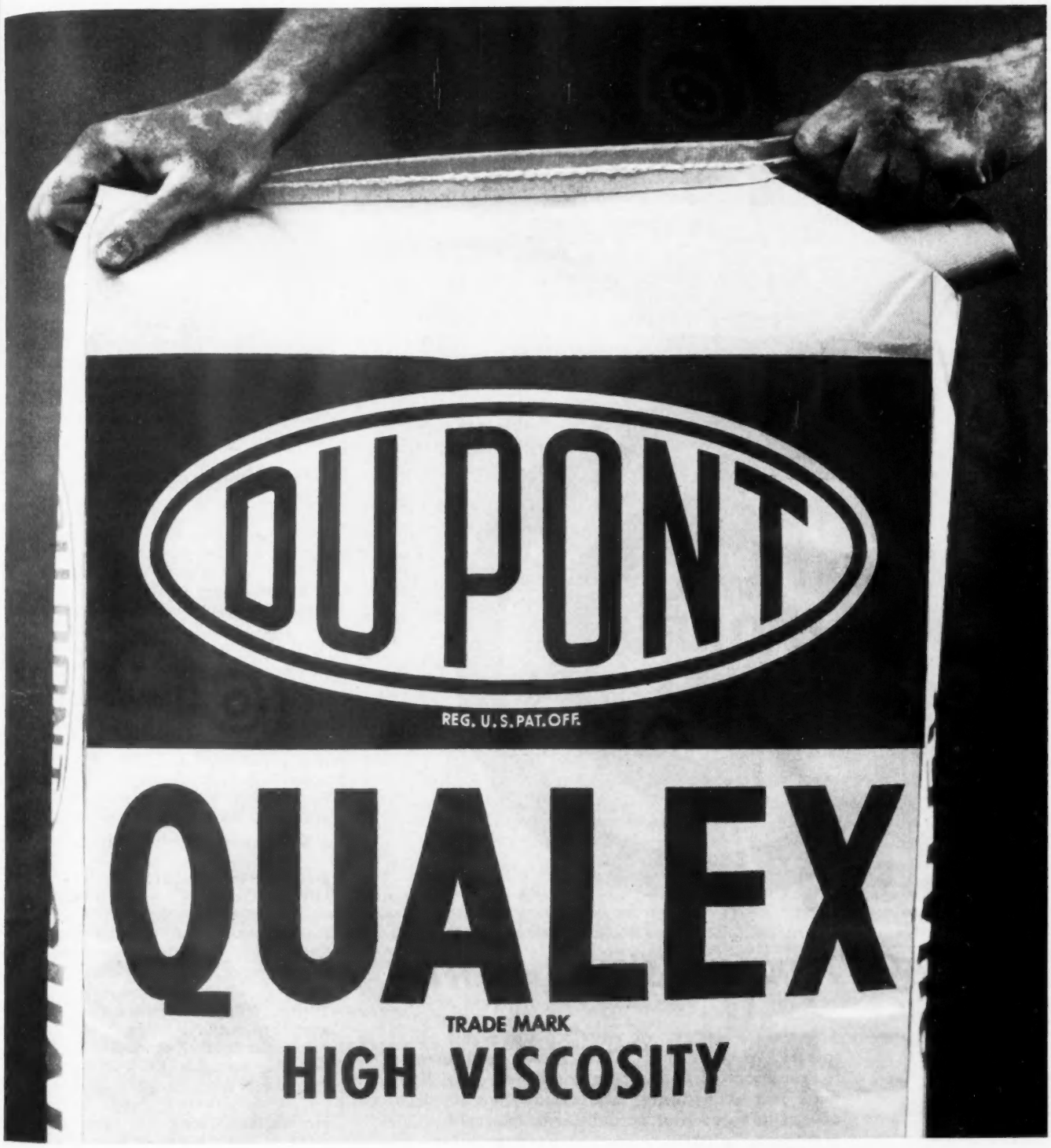

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Men in the industry

Joseph P. D. Hull, Jr., formerly a staff geologist exploration in the Canadian Division at Calgary, Alta., for **Kerr-McGee Oil Industries, Inc.,** has been named district geologist directing the work of the new Pittsburgh office recently opened there by Kerr-McGee.

William H. Swinbank has been named assistant manager of the Supply and Distribution Department for **La Gloria Oil and Gas Company,** the wholly owned subsidiary of **Texas Eastern Transmission Corporation.**

Lawson F. Jacks has been named district exploration superintendent for **Pan American Petroleum Corporation's** Lubbock, Texas, Exploration District.

Dr. T. J. O'Donnell, formerly director, Geophysical Research Division, has been named associate director of research at **Gulf Research & Development Company,** Harmarville, Pa.

M. W. Conn has been promoted to manager, Sales and Development Division, **Phillips Petroleum Company's** International Department, with headquarters in New York City. **I. L. Coffman** succeeds Conn as assistant division manager. Conn succeeds **John Getgood** who resigned as manager to become president of **Pacific Petroleums Ltd.,** partly owned by Phillips.

A. R. McLerran has officially opened the offices of his firm **A. R. McLerran and Associates, Consulting Engineers,** in Beaumont, Texas.

H. W. McCobb, who has spent 33 years in the international oil industry, has become regional coordinator for **Standard Oil Company (New Jersey)** operations in Asia, Australasia and parts of Africa. McCobb, a vice president and director of **Standard-Vacuum Oil Company,** plans to relinquish those responsibilities.

H. W. McCobb

Ira H. Cram, New York City, formerly senior vice president and chairman of the executive committee of the board of directors, **Continental Oil Company,** will continue as chairman of the executive committee and has become assistant to the President **L. F. McCollum.** Also, **A. W. Tarkington,** Houston, will continue as senior vice president and will be located in New York City. Tarkington's responsibilities will include the direction of foreign, corporate and financial activities. **John G. McLean,** Houston, formerly vice president, financial and transportation, has become financial vice president. **L. C. Peters,** Houston, vice president, coordination and supply, has become vice president, transportation and supply.

John Carpenter has joined the **Coral Drilling Company,** New Orleans, as assistant manager and special representative. He was formerly with The Offshore Company as industrial and public relations director.

Walter Wilds has been appointed manager, Pittsburgh Foreign Section, Treasury Department of the **Gulf Oil Corporation.** He succeeds **J. E. Allen** who has retired.

H. Walton Musick has been appointed director of purchases of **Kerr-McGee Oil Industries, Inc.** He has served as assistant director of purchases and also had been manager of the company's Office Services Department.

J. W. W. Whitney, Jr., has recently formed the **Whitney Operating Company,** specializing in operating and managing oil producing properties including unitized and secondary recovery properties. Whitney had been general production superintendent for Helmerich & Payne, Inc.

Hulusi Berilgen has been appointed chief petroleum engineer for **Mobil Exploration Mediterranean,** an affiliate of **Socony Mobil Oil Company, Inc.,** which is responsible for exploration in Turkey.

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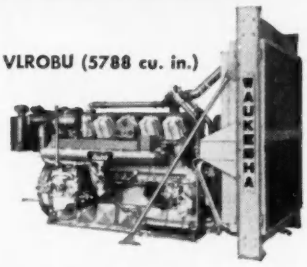
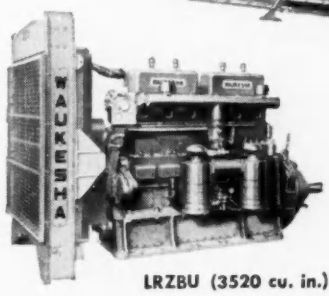


VLROBU (5788 cu. in.)



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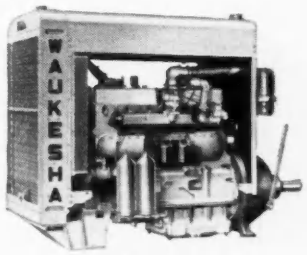
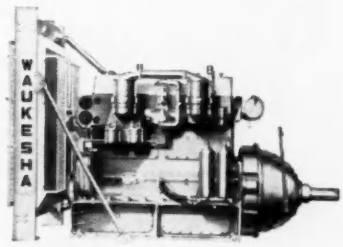


WAKCU (1197 cu. in.)



NKRBU (1905 cu. in.)

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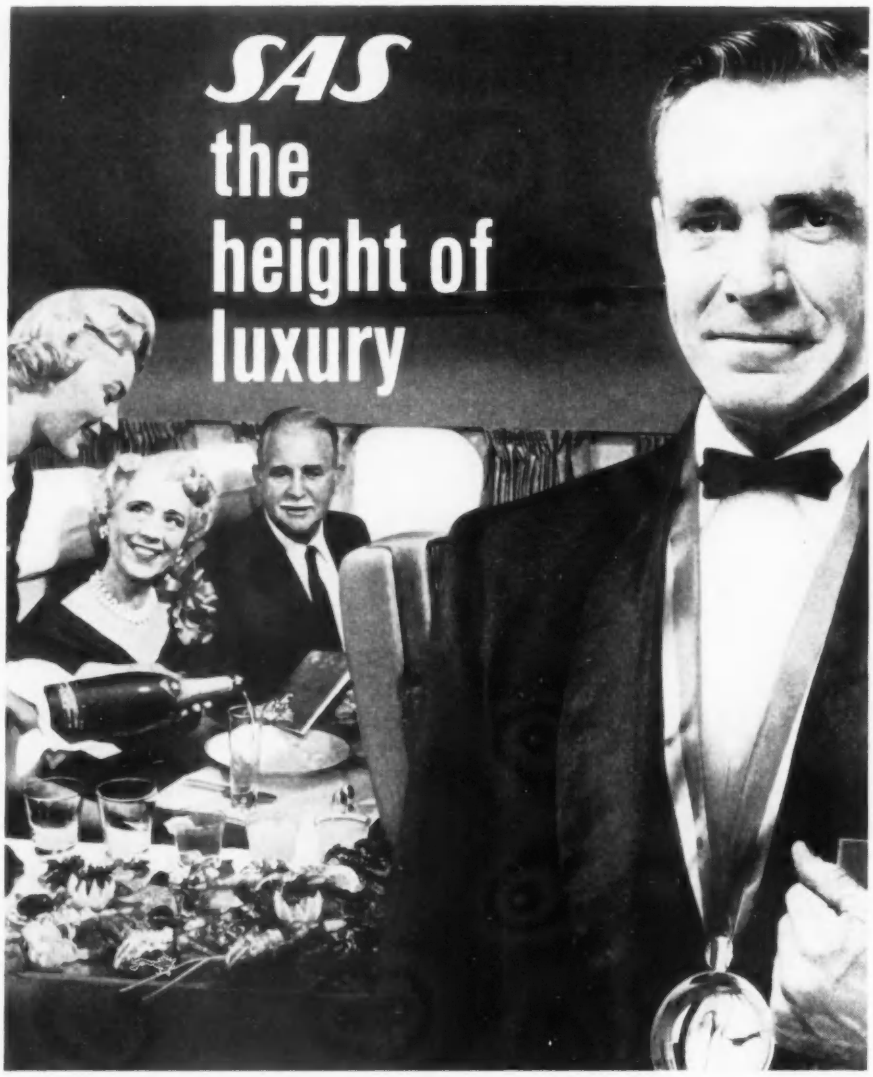
The ratings below are for standard engines without power consuming accessories

MEDIUM NATURAL GAS ENGINES					800	1000	1200	1400	1600	1800	2000	2200	2400	2600
MODEL	Features*	Bore & S.	Displ.	Torque–rpm	BRAKE HORSEPOWER AT SPEEDS INDICATED									
ICK	4-A	2½x3⅛	61	36-1600	5	6	8	9	11	12	14	15	16	
FC	4-Ir	3¼x4	133	88-1200	12	16	20	23	26	28	30	31	31	31
180-GKB	4-AC	3⅜x3¾	155	112-1400	15	20	25	30	34	37	39	42	43	
XAH	4-Ir	3⅜x4½	186	120-1400	16	22	27	32	36	39	42	42		
190-GLB	6-A	3¾x4	265	192-1200	29	36	44	50	57	62	66	67	67	
195-GL	6-A	4 x4	302	214-1200	32	40	49	57	63	68	72	75	76	
195-GK	6-A	4⅛x4	320	217-1400	32	40	49	58	66	74	80	87	93	
135-GZ	6-A	4⅜x5	451	315-1200	48	60	72	83	93	103	112	118	122	
135-GZ	6-AV	4⅜x5	451	315-1200	48	60	72	83	93	103	112	118	122	
140-GZ	6-A	4⅝x5½	554	395-1000	60	75	90	104	116	127	136	144	149	
140-GZ	6-AV	4⅝x5½	554	395-1000	60	75	90	104	116	127	136	144	149	
140-GZ	6-AV†	4⅝x5½	554	453-800	69	86	102	117	132	145	157	167	175	
145-GZ	6-A	5⅜x6	817	597-800	91	113	135	155	174	191	205	219	230	
145-GZ	6-AV	5⅜x6	817	597-800	91	113	135	155	174	191	205	219	230	
145-GZ	6-AV†	5⅜x6	817	646-1000	98	123	147	170	193	214	233	249	264	
WAKC	6-AV	6¼x6½	1197	900-800	137	171	204	236	264	283				
WAKC	6-AV†	6¼x6½	1197	1038-800	158	193	226	258	288	315				

LARGE NATURAL GAS ENGINES					600	700	800	900	1000	1100	1200
NKRB	6-ACV	7 x8¼	1905	1505-600	172	197	220	244	266	286	306
NKRB	6-ACV†	7 x8¼	1905	1600-600	183	211	238	265	288	313	334
LRORB	6-ACV	8½x8½	2894	2270-800	252	300	346	385	420	445	464
LRORB	6-ACV†	8½x8½	2894	2341-800	260	310	357	402	443	478	508
LRZB	6-ACV	9⅜x8½	3250	2700-800	305	357	409	450	485	515	537
LRZB	6-ACV†	9⅜x8½	3250	2850-800	322	378	434	486	533	575	610
VLROB	12-ACV	8½x8½	5788	4590-600	524	601	672	743	807	859	890
VLROB	12-ACV†	8½x8½	5788	4985-700	562	665	753	835	911	978	1027

*FEATURES: **4, 6, 12**—No. Cylinders; **A**—Aluminum Pistons; **C**—Counterbalanced; **Ir**—Cast Iron Pistons; **V**—Vibration Dampener.
†Special high compression ratios for higher horsepower and better economy to be fueled with dry methane type gas having a high heat value of 1150 BTU/cu. ft. or less.



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Men in the industry

Fred E. Buchanan, formerly administrative assistant to the management of **Sun Oil Company's** Gulf Coast Production Division at Beaumont, Texas, has become executive assistant to the division manager, **Donelson Caffery.**

Robert G. Hawthorne has been promoted to senior research engineer at **Union Oil Company of California's Research Center,** Brea, Calif.

Wallace W. Wilson has been promoted to vice president of **Continental Illinois National Bank and Trust Company of Chicago.** Wilson currently serves on committees of the Interstate Oil Compact Commission and the American Petroleum Institute and is a member of the Society of Petroleum Engineers (AIME). Wilson joined Continental in 1956 as a petroleum engineer in the bank's Oil and Public Utilities Loan Division and was elected second vice president in 1957.

W. W. Wilson

Jack W. Capps, landman, and **Don J. Eckelberg,** geologist, occupy the new offices in Casper, Wyo., for **Texas National Petroleum Company's** Rocky Mountain area.

Clarence W. Coffey, formerly comptroller of **The California Company** in New Orleans, has been elected vice president, secretary and treasurer of the firm. Coffey succeeds **Dee Davis** who has transferred to Denver as vice president, secretary and treasurer of the firm's Western Division, now being formed. **Jack K. Ellison,** formerly assistant comptroller has been named to succeed Coffey as comptroller.

Alton B. McClung, division geophysicist Denver, for **Texaco Inc.,** has been appointed assistant chief geophysicist and will be located in Houston. Also, **Francis A. Seamans,** assistant division geophysicist, has been advanced to division geophysicist to succeed McClung.

Edward L. Steiniger has been elected a director of **Richfield Oil Corporation** succeeding retired **P. W. Thirtle.**

Edward W. Nicholson has been named an assistant director in the Products Research Division of **Esso Research and Engineering Company.**

Gene L. Shaw has been promoted to the position of regional geologist for the Rocky Mountain Region for **Lion Oil Company, Division of Monsanto Chemical Company.** Shaw succeeds **T. W. Lins** who has transferred to the "technical advancement route."

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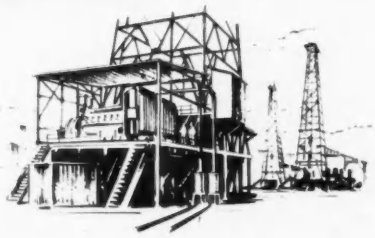

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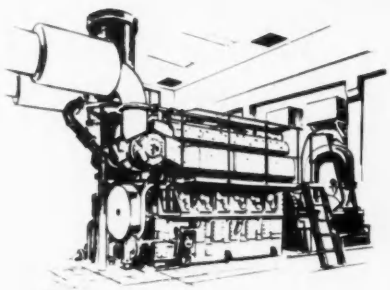

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Associations

Los Angeles NOMADS Chapter Elects Officers

Incoming and retiring officers at the Annual Business Meeting of the Los Angeles Chapter of Nomads held recently. From left to right (front row), P. M. Bowen of Martin-Decker Corporation, treasurer 1960; C. C. Sutton of Oil Well Mfg. Co., assistant secretary 1960; Charles M. King of Baker Oil Tools, Inc., president 1961; Louis Q. Webber of Martin-Decker Corporation, treasurer 1961; Lee J. Laird of Ladish Pacific Division, sergeant-at-arms 1961, and John Cochran of Dritol, assistant treasurer 1961. Back row (left to right), Robert P. Gaylord of Wagner-Morehouse, Inc., senior regent 1960; B. Bronzan of McCullough Tool Co., deputy sergeant-at-arms 1960; Earl M. Daniels of Hydril Company, regent 1960; Tom R. Ashe of Globe Oil Tools Co., regent 1961, and Henry W. Pullman of Baker Oil Tools, Inc., senior regent 1961.

Governor Daniel of Texas Elected Chairman of IOCC

Governor Price Daniel of Texas has been elected chairman of the Interstate Oil Compact Commission for a one-year term, succeeding Governor George Docking of Kansas.

The conservation group also elected Dr. Walter Jones, Tuscaloosa, Ala., first vice president and Fred Moran, Owensboro, Ky., second vice president. Lawrence R. Alley and Earl Foster, both of Oklahoma City, were re-elected executive secretary and general counsel, respectively.

Foster, who has been with the Compact since 1944, has announced his retirement effective January 1, 1962. Before becoming general counsel he served as executive secretary of the organization. He has held the post of general counsel for three years.

Corrosion Short Courses Sponsored by NACE

The last three of four short courses on corrosion sponsored or endorsed by the National Association of Corrosion Engineers will be held in February and June. The first of the courses was to have been held February 2-3 in Houston.

The annual short course sponsored by the NACE Shreveport Section was scheduled for February 14-15, at Centenary College in Shreveport.

The sixth Annual Appalachian Underground Corrosion Short Course will be held June 6-8, under the sponsorship of the University of West Virginia at Morgantown.

A three-day short course in corrosion control under the sponsorship of the NACE Greater Boston Section has been planned for June 20-22. The course will be held at Wentworth Institute, Boston.

Two-Day Petroleum Study Is Scheduled for Dallas

A two-day study devoted to economics of petroleum exploration, development and property valuation will be held in Dallas, March 16-17. Presented by the International Oil and Gas Educational Center, the program will be conducted at the Southwestern Legal Center on the campus of Southern Methodist University.

Subjects slated for review, and speakers are: Petroleum Exploration—Gambling Game or Business Venture?, Edgar W. Owen, consulting geologist, San Antonio; Exploration for Stratigraphic Traps, A. I. Levorsen, consulting geologist, Tulsa; Reducing Oil-Finding Costs by Use of Hydrodynamic Evaluations, Gilman A. Hill, president, Petroleum Corporation; Reducing Hidden Exploration Costs, D. M. E. McLarty, petroleum consultant, Denver; Problems of Foreign Exploration, John C. Dunlap, consulting geologist, Dallas; Cutting Costs of Well Completions and Operations, Marion H. Stekoll Petroleum Company, and Profitability of Proposed Exploratory Ventures, J. J. Arps, vice president, Economics and Evaluation Department, The British-

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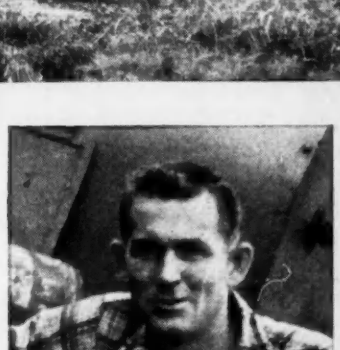

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American Oil Producing Co. Also, The Ever-Changing Fair Market Value, John M. Murrell, president, DeGolyer & MacNaughton; Financing Property Acquisitions, Eugene McElvaney, senior vice president, First National Bank in Dallas, and Evaluation of Secondary Recovery Prospects, Paul D. Torrey, Department of Petroleum Engineering, The University of Texas.

A question, answer and discussion period will be held at the close of the session each day.

Serving as chairmen during the program will be Frank B. Conselman of Abilene, Texas, vice president of the American Association of Petroleum Geologists, Norman C. Smith, consulting geologist of Dallas, R. C. Earlougher, petroleum engineer from Tulsa, and R. M. Swesnik, vice president of the General American Oil Company of Texas.

Persons attending the program will be entertained at a reception on March 16 from 5:30 until 7 p.m. at the Dallas Country Club.

Tuition charge for persons registering in advance of the program will be $30. A $35 fee will be charged those registering at the time of the program.

Additional information or copies of the program may be obtained from the International Oil and Gas Educational Center, 3315 Daniels, Dallas 5, Texas, telephone EMerson 3-1023.

Western Association Re-Elects Howard G. Vesper President

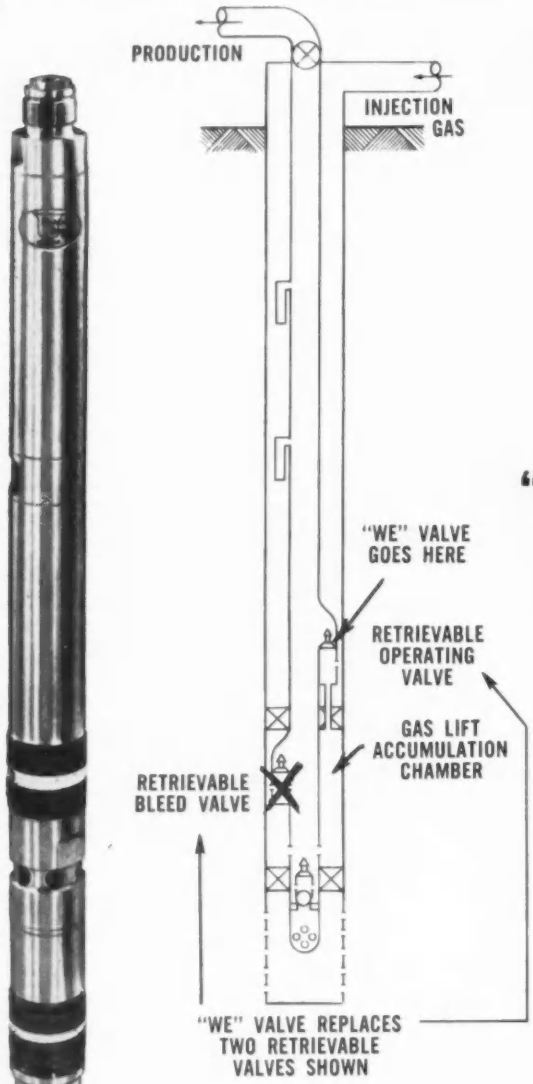
Howard G. Vesper, president of the Standard Oil Company of California Western Operations, Inc., has been re-elected president of the Western Oil and Gas Association for 1961.

H. G. Vesper

Other officers elected were George F. Getty, II, president, Tidewater Oil Company, first vice president; R. R. Von Hagen, president, Lloyd Corporation, Ltd., second vice president; Stuart H. Durkee, vice president and treasurer, The Superior Oil Company, re-elected treasurer and Felix Chappellet was re-elected secretary, vice president and general manager of the Association.

Re-elected to the board of directors were: A. M. Bell, Jr., vice president, Gulf Oil Corporation of California; S. F. Bowlby, vice president, Shell Oil Company; H. D. Campbell, president, Francis Western Oil Company; L. A. Cranson, president, Honolulu Oil Corporation; B. E. Devere, president, Pathfinder Petroleum Company; John H. Douma, vice president, Sunray Mid-Continent Oil Company; Mr. Durkee; Rollin Eckis, executive vice president, Richfield Oil Corporation; Ralph Edgington, president, Edgington Oil Refineries, Inc.; J. M. Feldman, president, Golden Bear Oil Company; Mr. Getty; Russell H. Green, president, Signal Oil and Gas Company; E. B. Hall, president, Drilling and Production Company; N. N. Jones, acting manager California area, Humble Oil & Refining Company; Olen Lane, vice president, Continental Oil Company; P. S. Magruder, assistant to the president, Mobil Oil Company.

Downs McCloskey, manager California division, Amerada Petroleum Corporation; Ross McCollum, president, National Oil Company; Raymond D. McGranahan, president, Wilshire Oil Company of California; C. Edward Miller, chairman of the board, Time Oil Company; I. G. Morgan, vice president, Texaco Inc.; Harold C. Morton, partner, Morton and Dolley; Lee S. Osborne, vice president, Union Pacific Railroad Company; Howard C. Pyle, president, Monterey Oil Company; Herbert L. Reid, executive vice president, Kern County Land Company; George Sowards, division manager, The Ohio Oil Company; John L. Stephens, vice president, Chanslor-Western Oil and Development Company; Dudley Tower, president, Union Oil Company of California; Jasper W. Tully, president, Reserve Oil and Gas Company; Vesper and Von Hagen.



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L. C. Burroughs Joins API As Consultant

Leland C. Burroughs, assistant to the vice president of Shell Oil Company in New York, has joined the American Petroleum Institute as a consultant on air and water pollution.

In his new position Burroughs will serve as coordinator of API activities in the field of pollution research and abatement. He will administer the API technical committees concerned with air and water pollution and will serve as liaison between API and all agencies whose interest in air and water pollution work touches on fields of interest to the petroleum industry.

Burroughs was chosen for the position on the strength of his record of 25 years of activity in pollution abatement.

NACE Elects E. C. Greco President for 1961-62

Edward C. Greco, senior research chemist of the Research Department, United Gas Corporation, Shreveport, La., has been elected president of the National Association of Corrosion Engineers for 1961-62. Greco will take office on March 17, the last day of the NACE Seventeenth Annual Conference in Buffalo, N. Y.

Other officers are: Rolland McFarland, secretary and technical director of Hills-McCanna Co., Chicago, vice president, and C. G. Gribble, Jr., district manager for the Metal Goods Corporation, Houston, treasurer.

Three directors of the association were also elected. They are: Frank E. Kulman, senior engineer, Consolidated Edison Company of New York, Inc.; Dr. L. W. Gleekman, supervisor of the materials engineering group, Engineering Department of Wyandotte Chemicals Corp., Wyandotte, Mich., and Fred D. Stull, superintendent of corrosion prevention, Texas Gas Transmission Corp., Owensboro, Ky. Kulman will represent active members of NACE, while Dr. Gleekman and Stull will represent corporate members.

API Production Division Forms New Louisiana Group

The Division of Production of the American Petroleum Institute has announced the formation of a new Chapter at Monroe, La.

Officers of the Monroe Chapter are J. S. Stone, United Carbon Co., chairman; W. H. Throop, Schlumberger Well Surveying Corp., vice chairman, and Harold L. Woods, Jr., Harway Producers, secretary-treasurer.

This brings to 32 the number of such groups formed by the division in various states. Purpose of the organizations is to provide forums for the exchange of ideas on petroleum technology and industry developments, according to Alden S. Donnelly of Honolulu Oil Corp., chairman of the division's Committee on District Activities.

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Associations

New Orleans Society Elects 1961 Officers

Jules Braunstein, Shell Oil Company, has been elected president of the New Orleans Geophysical Society for 1961.

Other officers elected were: Leonard L. Limes, Kerr-McGee Oil Industries, Inc., vice president; L. W. Funkhouser, The California Company, director; Jack D. Cox, John W. Mecom, treasurer, and David N. Schnell, Superior Oil Company, secretary.

These new officers will serve the society through September 1961.

Oklahoma University To Host Southwestern Gas Short Course

The thirty-sixth annual Southwestern Gas Measurement Short Course will be held on the North Campus, University of Oklahoma, Norman, April 18, 19 and 20. The general committee has selected 89 class subjects and instructors. Thirty-three manufacturers will have educational exhibits with representatives in attendance to answer questions and discuss application of the various items exhibited.

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26 to Mar. 2	AIME Annual Meeting, Penn-Sheraton Hotel, Pittsburgh, Pa.
26 to Mar 2	Society of Petroleum Engineers of AIME Annual Meeting, Chase & Park Plaza Hotels, St. Louis, Mo.
28 Thru Mar. 1	New York Regional Conference on Employe Communications, Committee on Public Affairs (API), Park-Sheraton Hotel, New York City.
Mar. – 2	PESA, North Mid-Continent District, Mayo Hotel, Tulsa.
– 5	Sixth Annual Gas Turbine Conference and Products Show, Shoreham Hotel, Washington, D.C.
– 7	PESA, Pacific District, Ambassador Hotel, Los Angeles.
5– 9	ASME Gas Turbine Power Conference & Exhibit, Co-Sponsored by U.S. Department of Defense, Shoreham Hotel, Washington, D.C.
8– 9	Chicago Regional Conference on Employe Communications, Committee on Public Affairs (API), Sheraton-Towers Hotel, Chicago.
8–10	API Division of Production, Southern District Meeting, Captain Shreve & Washington-Youree Hotels, Shreveport, La.
13–17	National Association of Corrosion Engineers, Annual Meeting & Corrosion Show, Hotel Statler, Buffalo, N.Y.
22–24	API Division of Production, Southwestern District Meeting, Cole Hotel, Albuquerque, N.M.
27–29	Midwest Gas Association, Annual Meeting & Convention, Sheraton-Fontenelle Hotel, Omaha, Neb.
27–29	Saudia Arabia Section of SPE of AIME, Regional Meeting, Durhan, Saudia Arabia.
30 Thru April 1	Fourth Symposium on Rock Mechanics, Pennsylvania State University, University Park, Pa.
April 4– 5	Gas Compressor Institute, Southwest Kansas Center, Liberal, Kan.
5– 7	API Division of Production, Mid-Continent District Meeting, The Mayo Hotel, Tulsa.
9–11	SEG, Fourteenth Annual Mid-Western Meeting, Skirvin Tower Hotel, Oklahoma City.
9–13	ASME Oil & Gas Power Conference & Exhibit, Jung Hotel, New Orleans
11–13	PESA & PIEA 1961 Conference and Exhibit, Galveston, Texas.
20–21	1961 West Texas Oil Lifting Short Course, Texas Technological College, Lubbock, Texas.
20–21	Society of Petroleum Engineers of AIME, East Texas-Lou-Ark., Gas Technology Symposium, Site Unreported, Tyler, Texas.
24–27	AAPG-SEPM and Rocky Mountain Section, AAPG Annual Meeting, Denver Hilton Hotel, Denver.

Nomads' Chapter monthly meeting: Los Angeles, second Wednesday, Biltmore Hotel, Wallace A. Sawdon, Secretary. Houston, second Monday, Ye Old College Inn, Elbert T. Walker, Secretary. Dallas-Fort Worth, first Monday, Greater Dallas Club, Hank Davis, Secretary. Tulsa, Hotel Tulsa, Gilbert Swift, Secretary. New York, first Monday, Hotel Biltmore, Jesse E. Hickman, Secretary.

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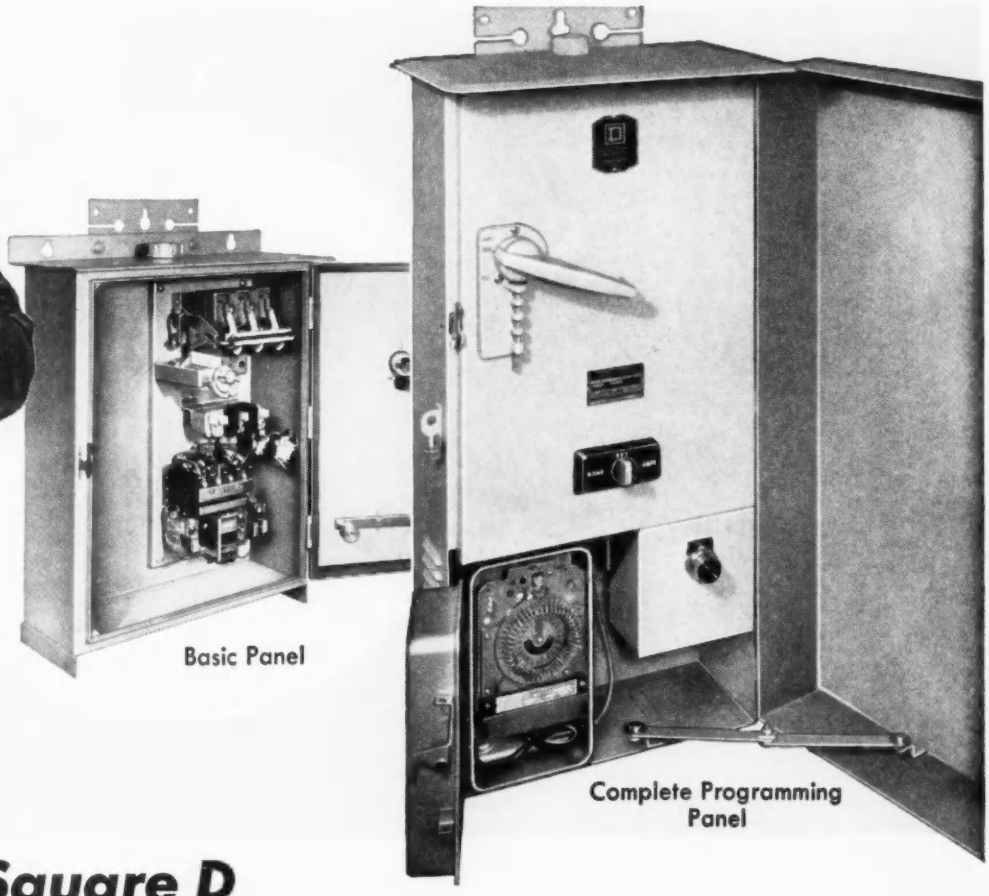

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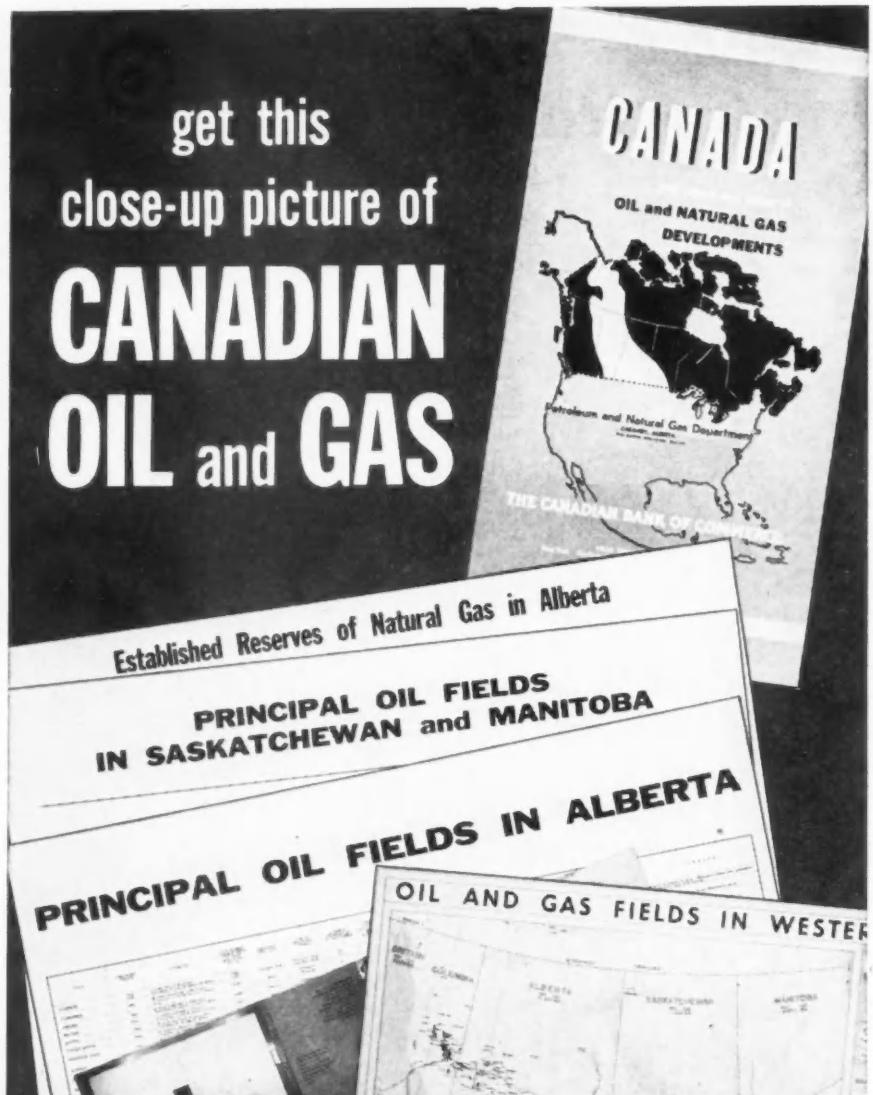

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New Books

MINING DEVELOPMENTS IN ASIA AND THE FAR EAST 1957, MINERAL RESOURCES DEVELOPMENT SERIES NO. 11, United Nations Publications, 75 Cents.

This present report is the seventh in the series of annual reviews of mining developments in Asia and the Far East.

DAWSON BAY FORMATION IN THE QUILL LAKES—QU'APPELLE AREA, SASKATCHEWAN, Saskatchewan Bureau of Mineral Resources, prepared by D. M. Lane, $1.

This report constitutes a study of the Middle Devonian Dawson Bay formation in an area of the province lying between township 12 and township 44, and which is bounded on the west by range two, west of the third meridian, and on the east by the Manitoba-Saskatchewan border. The author discusses oil and gas possibilities of the Dawson Bay in the area and relates this formation to the potash beds in the underlying Prairie Evaporite formation.

PETROLEUM RESERVOIR ENGINEERING, PHYSICAL PROPERTIES, McGraw-Hill Book Company, Inc., New York, James W. Amyx, Daniel M. Bass, Jr., and Robert L. Whiting, $17.50.

This is the first volume of a two-volume work on reservoir engineering. It develops the fundamentals of rock and fluid properties on which reservoir engineering is based. Methods of data evaluation for reservoir engineering purposes are included together with applications of rock and fluid properties for determination of oil or gas in place.

McALESTER-ARKANSAS VALLEY BASIN REFERENCE BOOK, Rhinehart Oil News Company, Dallas.

According to the publisher, this is the first complete reference book devoted exclusively to this potential boom area, the 19 county McAlester-Arkansas Valley Basin area.

Containing 230 pages of basic information about a finger-like strip, extending from Coal County, Oklahoma, northeastward into East Central Arkansas, the volume concentrates on discoveries, producing zones, number of wells drilled, deepest tests, formation records. Also included in the publication are field maps, key electrical logs and nine exclusive aerial photos.

THE GEOLOGY OF THE FORBES LAKE AREA by Dr. W. J. Pearson and E. Froese, and **THE GEOLOGY OF THE BRABANT LAKE AREA** by Dr. S. J. T. Kirkland, Saskatchewan Department of Mineral Resources.

The two publications are final geological reports related to the geological work carried out in the Saskatchewan pre-Cambrian shield.

New books

GRAPTOLITE FAUNAS OF THE MARATHON REGION, WEST TEXAS, Bureau of Economic Geology, The University of Texas, Austin, Texas, William B. N. Berry, $3.

This paper-cover publication contains detailed descriptions and excellent photographic illustrations of a large number of the graptolite fossil species. The accompanying index map shows position of the 18 measured sections and the 152 collection localities.

PETROLEUM REVIEW, MITCHELL COUNTY, TEXAS, Phifer Petroleum Publications, Houston, Robert L. Phifer, $10.

Facts and figures on the 22 fields that have been discovered since 1920 have been compiled by the author from the records and hearing files of the Railroad Commission of Texas. There are 21 illustrations including a map of the county with the fields in color, logs of discovery wells and structure maps. Data is current through August 1959.

PROCEEDINGS OF THE SYMPOSIUM ON THE DEVELOPMENT OF PETROLEUM RESOURCES OF ASIA AND THE FAR EAST, MINERAL RESOURCES DEVELOPMENT SERIES NO. 10, United Nations Publication, $2.50.

This publication contains the report and the principal documents of the Symposium on the Development of Petroleum Resources of Asia and the Far East, which was held in New Delhi, India, from December 3-16, 1958, under the sponsorship of the United Nations Commission for Asia and the Far East (ECAFE).

The publication consists of two parts: Part I, Report of the Symposium and Part II, Documentation. Part II is further divided into A. Documents of general scope; B. Documents pertaining to the ECAFE region as a whole; C. Documents relating to petroleum resources development in countries of the ECAFE region; D. Documents relating to petroleum resources development in countries outside the ECAFE region and E. Documents concerning regulations governing petroleum resources development. Only brief summaries of the main points have been brought out in sections D. and E.

ANNEX TO THE PROCEEDINGS OF THE SYMPOSIUM ON THE DEVELOPMENT OF PETROLEUM RESOURCES OF ASIA AND THE FAR EAST, MINERAL RESOURCES DEVELOPMENT SERIES NO. 10 (ANNEX), United Nations Publication, $1.

This is the annex of the Proceedings of the Symposium on the Development of Petroleum Resources of Asia and the Far East (Mineral Resources Development Series No. 10), issued April 1959.

The annex consists of 72 figures for the documents included in this publication.

Congrats and $25 for this quip to G. A. KRAFT, 17 Van Berwaerdeweg, The Hague, Netherlands

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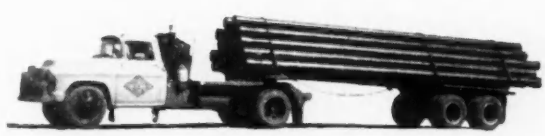

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New books

VOCATIONAL AND PROFESSIONAL MONOGRAPHS - ENGINEERING, Bellman Publishing Company, Cambridge 38, Mass., Edward H. Robie, $1.

This is No. 14 in the series of monographs in the Vocational and Professional Monograph series. Addressed primarily to high school students and to their parents and vocational counselors, these monographs are used in connection with guidance activities wherever general counseling work is conducted and for individual reference purposes in the choice of a career.

The booklet contains a complete list of engineering schools in the United States that have one or more accredited curricula, broken down into six geographical areas, with the curricula accredited in each school, and the engineering enrollment of each institution.

TRANSACTIONS, VOLUME IX, GULF COAST ASSOCIATION OF GEOLOGICAL SOCIETIES, Cambe Log Library, 718 Milam Street, Houston, $5.50 postpaid.

This 321-page volume contains technical papers and abstracts from the Ninth Annual Convention of the GCAGS and the 1959 fall regional meeting of The American Association of Petroleum Geologists, November 11-13, 1959. It contains such outstanding papers as Gulf Coast Cenezoic History, by J. D. M. Williamson; Sedimentation and Structure, Jackson Group, South-Central Texas, by D. Hoye Eargle; Erosional Channel in Middle Wilcox near Yoakum, Lavaca County, Texas, by William V. Hoyt; Occurrence of Miocene Oil in South Louisiana, by L. L. Limes and Jack C. Stipe; Structural Features of the Sunniland Oil Field, Collier County, Florida, by H. S. Puri and J. E. Banks; Geology and Petroleum Development of the Continental Shelf of the Gulf of Mexico by Gordon I. Atwater; and numerous other fine articles.

FIELD TRIP GUIDEBOOK, RECENT SEDIMENTS OF THE NORTH-CENTRAL GULF COASTAL PLAIN, Cambe Log Library, 718 Milam Street, Houston, $4 postpaid.

Plain is an 84-page book published in connection with the Ninth Annual Convention of the GCAGS and the 1959 fall regional meeting of AAPG, November 11-13, 1959. This book includes a road log from Houston to Beaumont via Galveston Island and Bolivar Peninsula; to vicinity of Creole, Louisiana, and return to Houston via Lake Charles. There are 22 plates, illustrating development of the Gulf coast line through recent geologic history up to the present time.

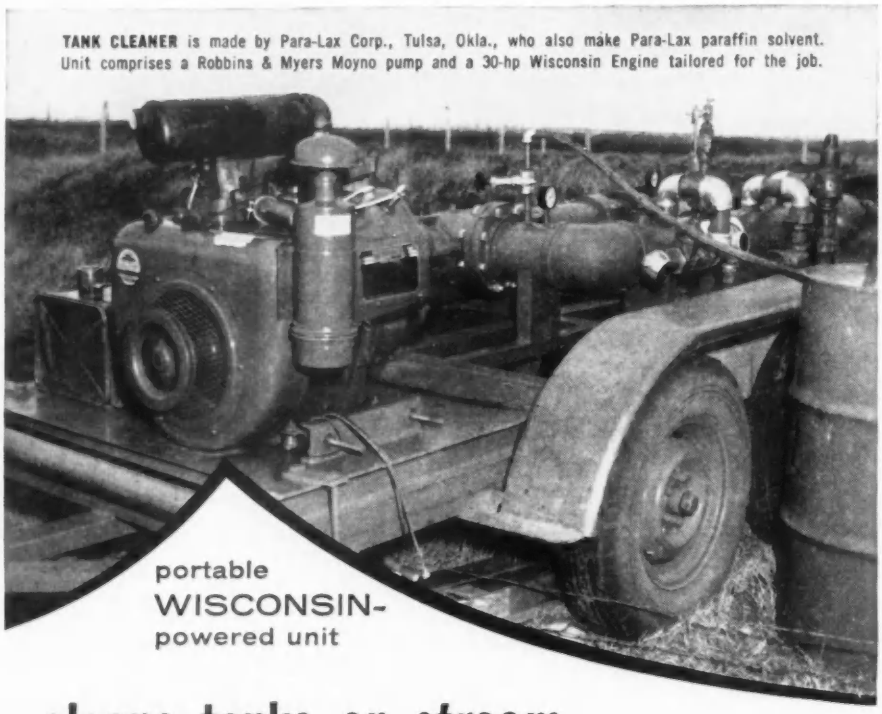
THE COMPOSITE INTERPRETIVE METHOD OF LOGGING DRILL CUTTINGS, Oklahoma Geological Survey, Norman, Okla., John C. Maher, $1.50.

This report has been prepared primarily to provide a reference, a manual and a set of descriptive standards for subsurface investigations in the Mid-Continent region.

As a reference, it provides details and commonly used procedures which cannot be fully described in every surface report. As a manual, it should aid in orienting or training geologists in subsurface methods. As a set of descriptive standards, it is hoped it will encourage greater care and standardization in all phases of preparation of sample logs because these logs form the foundation upon which the geologic history of sedimentary basins may be reconstructed.

PETROLEUM REVIEW, SCURRY COUNTY, TEXAS, Phifer Petroleum Publications, P. O. Box 6014, Houston 6, Texas, Robert L. Phifer, $15.

This review was compiled from the record and hearing files of the Railroad Commission of Texas. Offers complete history of each of the 62 fields discovered in Scurry County since 1923. The individual field record lists location, discovery well, surveys (block and section numbers), known subsurface structural data, rules and regulations and many other important facts and figures. The 47 illustrations include structure maps, logs of discovery wells and a map of the county with the fields in color. Information is current through September 1959.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cleans tanks *on-stream*... and recovers good oil from settlings

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Suppliers' notes

BJ Service Opens New Texas Offices

A. M. Bernie, vice president (left), and John B. Merritt, president of BJ Service, Inc., discuss new facility at Arlington, Texas, with Robert S. Ingersoll (right), president and chief executive officer of parent Borg-Warner Corporation.

C. E. Macdonald has joined the **Atlas Bradford Company** of Houston as manager of the Export Department. Macdonald was formerly with Worldwide Supply Company, Inc.

Ivan M. Fischer was named "salesman of the year" at the annual meeting of the **Lone Star Steel Company** sales force held recently.

E. P. Berg

E. S. Everitt

Eugene P. Berg and **Ernest S. Everitt** have been elected to the board of directors of the **Bucyrus-Erie Company.**

I. B. Allen has been appointed manager of a new specialty products sales division of **Eastman Oil Well Survey Company.**

Jimmy Abercrombie was appointed a **Technical Oil Tool Corporation** service representative in the Mississippi-Alabama area. Abercrombie will work directly under the supervision of **Howard Reid**, TOTC area manager.

Over 1100 field installations
... less than 2% maintenance!

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FRICTIONAL TUBING ANCHOR

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- Smooth gripping members hydraulically actuated
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- No drag on casing going in hole or coming out unless tubing is pulled "wet"
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Compensates both up and down

Complete range of sizes for 4½" to 11¾" API Casing. Write for complete information.

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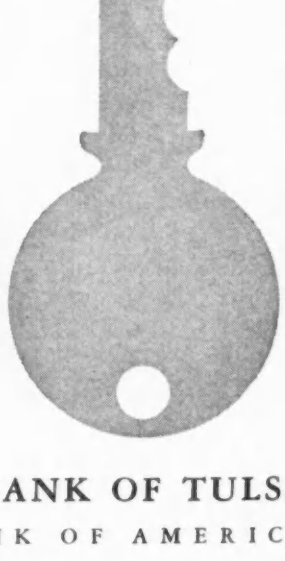

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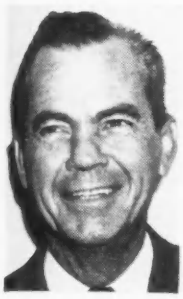
Suppliers' notes

J. C. Lattimore

A. F. Criger



R. D. Young

R. D. Arnold

A. F. (Whimpy) Criger has been assigned to division offices in Casper, Wyo., by **Houston Oil Field Material Company, Inc.** Also, **Jack C. Lattimore** has been assigned to the Tulsa office; **Rowland D. Young** has been assigned to Denver, and **Richard D. Arnold** has been assigned to New Orleans.

Marion A. Foreman, regional manager in Midland, Texas, for **Hughes Tool Company,** has been promoted to the newly created position of national representative —rock bits. Also, **Frank C. Ratcliff,** division sales manager at Houma, La., will replace Foreman at Midland.

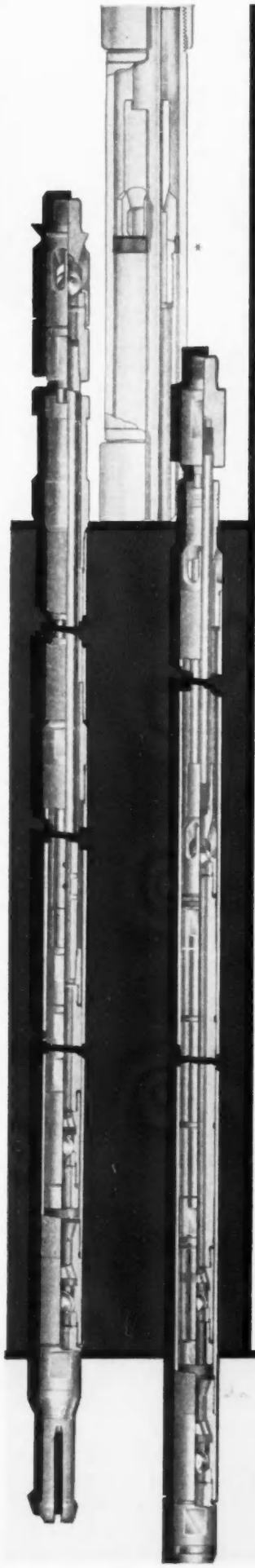
Billy Wayne Rogers has been appointed South Louisiana district manager for **Pipe Inspectors Division of Plastic Applicators, Inc.**

William T. Cushing, Jr., has been appointed assistant manager of the London, England, office of **The National Supply Company's** Export Division.

Bob Altenreid has joined **Chris Well Servicing Company, Ltd.,** and affiliated companies.

R. F. (Pat) Landry has been appointed sales representative for **Bovaird Supply Company** in the South Louisiana area. He will headquarter in New Iberia and work under the supervision of **Jack Youngling,** Bovaird Gulf Coast district manager in Houston.

B. R. Noel has recently opened his own company, **Noel Service Company** in Shreveport, La. The new company is the exclusive agent for Triple L Automatic Drillers in the Ark-La-Tex area.



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PUMPS

...for sandy wells to eliminate the sanding-in hazard of bottom anchoring a 1" bore pump in 1¼" tubing. The top of this unique Slim Hole Pump is fitted with a brass ring. When the pump is seated the brass ring is pressed into a sealing nipple properly spaced above the shoe in the tubing string. This prevents sanding-in by sealing the pump-tubing annulus . . . another problem solved with one of the many combinations developed by OILMASTER for Slim Hole completions.

The dependable basic features long characteristic of standard size OILMASTER pumps are built into all OILMASTER Slim Hole Pumps. Even gassy wells are no problem . . . Oilmaster's Slim Hole Pump is available in Ratio-Compound as well as Conventional design . . . for both 1¼" and 1½" tubing.

The development of an economic and dependable means of producing a slim hole completion is more of how OILMASTER works for you. Your OILMASTER or National Supply representative can give you all the details . . . or contact these co-distributors: **Beacon Supply Company, Dominion Oilfields Supply Company, Limited, Industrial Supply Company, Union Supply Company. For other literature write to FLUID PACKED PUMP, 9100 S. Norwalk Blvd., Los Nietos, Calif.**

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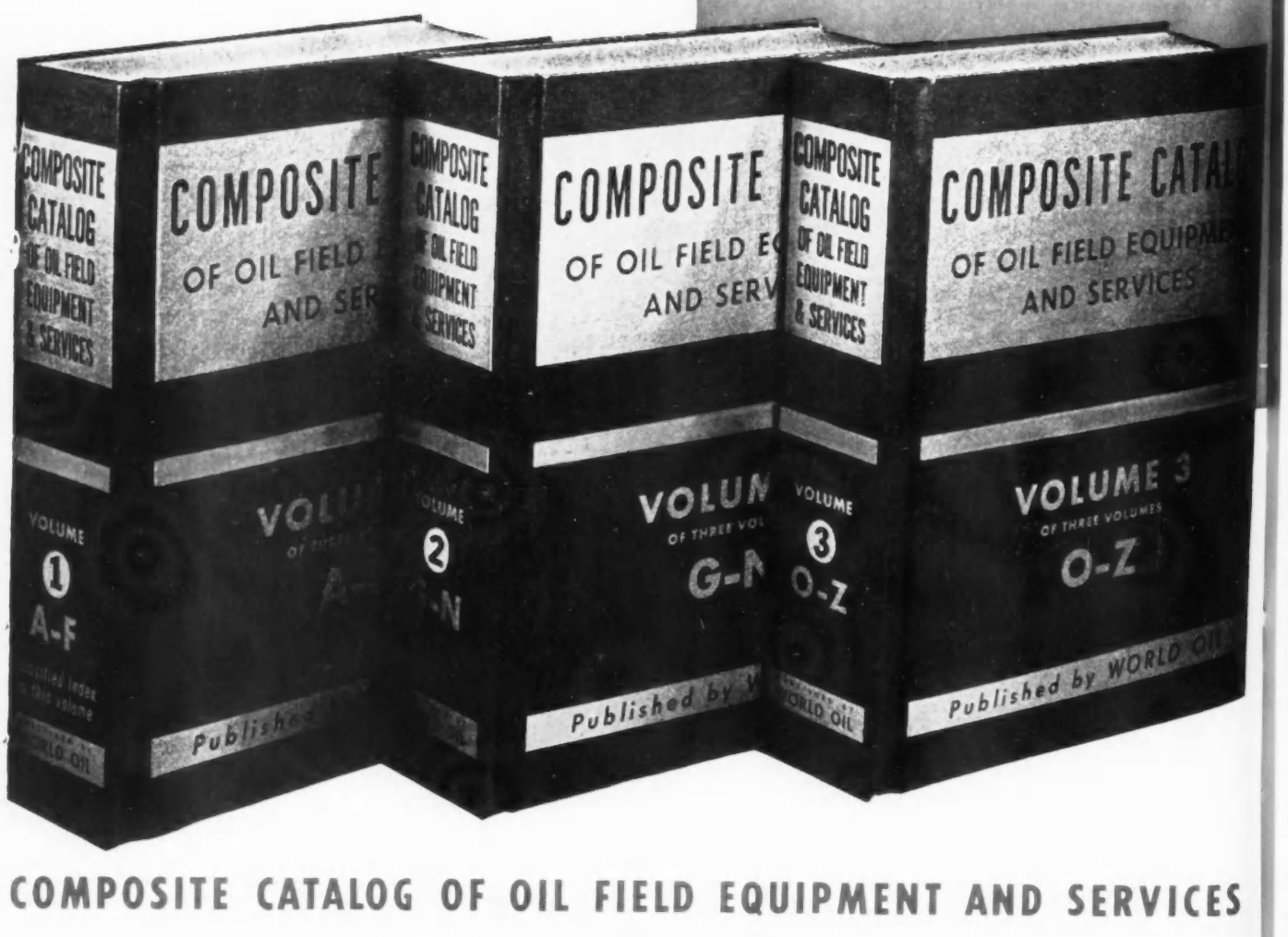


COMPOSITE CATALOG OF OIL FIELD EQUIPMENT AND SERVICES

Published by World Oil, P.O. Box 2608, Houston

Suppliers' notes

Robert W. Johnson has been appointed vice president, Marketing and Sales, for **Graver Tank & Mfg. Co., Division-Union Tank Car Company.** Johnson will be located in East Chicago, Ind.

D. R. Yager, Central Region vice president for **Halliburton Company** retired on January 1, following nearly 35 years with the firm. **E. L. Paramore,** who was Southern Region vice president was named to take charge of the firm's Central Region. **Travis Phillips,** Shreveport, La., will succeed Paramore as Southern Regional director. **C. L. (Steamboat) Fulton,** assistant division manager at Midland, Texas, moved to Shreveport as division manager there. **F. C. Moody,** assistant division manager at Denver, has moved to Midland and will hold the same position. **C. L. Bramlet,** assistant division manager at Corpus Christi, Texas, has succeeded Moody in Denver as assistant division manager.

Lester A. Carlson, Jr., has been appointed sales manager, Production Equipment, for **The National Supply Company.** He succeeds **Gerald R. Bond** who has been transferred to the **Fluid Packed Pump Company Division.**

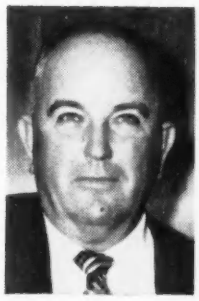
S. G. Stroud

Stanley G. Stroud has been appointed to the position of coordinator-logging for **McCullough Tool Company.** Stroud will headquarter in Los Angeles and his duties will include the coordination and integration of logging methods and techniques on a company-wide basis.

John R. Feeser has been promoted to the position of assistant to the director of North American Sales of **Camco, Incorporated.** Feeser joined the company last March where he was a new products engineer.

Claude H. Collier has joined the sales and service staff of **Tretolite Company** at Bound Brook, N. J. **Charles W. Fetrow,** has become Tretolite's representative at Springfield, Pa. Other additions to the Tretolite Sales Department include **D. L. Childress,** assigned to pilot the firm's new float plane servicing the South Louisiana District; **James A. Gregory,** assigned as field engineer trainee in the West Central Division, and **Carl R. Oglesby** has been assigned as a field service engineer at Mt. Vernon, Ill.

L. W. White has been appointed manager of Canadian Operations for **Otis Pressure Control, Incorporated,** a division of **Otis Engineering Corporation.** He will headquarter in Otis' Calgary office.



W. L. Hughes

P. C. Mayfield

W. L. (Bill) Hughes recently transferred from Midland, Texas, to assume duties of division manager in Oklahoma City for the **Halliburton Company.** Also, **P. C. (Bill) Mayfield** transferred from Oklahoma City to Midland to take charge there.

J. D. McNeill has been named by **Grove Valve and Regulator Company** a sales engineer for Grove production valves and pressure regulators in Canada. McNeill will assist **Morley Davies** who directs Grove's Canadian sales activities.

Hugh L. Morris and **Garland Kennon** have been appointed to the sales staff of **Mission Manufacturing Company.**

James A. Bailey has been appointed regional salesman, Production Equipment, at Midland, Texas, for **Jones & Laughlin Supply Division.**

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McKissick
TUBING BLOCKS
Standard of the Servicing Industry

FAST. . .
SAFE . . .
DEPENDABLE . . .

Broadest range of sizes, types and capacities . . . designed for all servicing use.

Be Specific . . . Get McKissick

McKissick
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Drawer 768 • Tulsa, Okla.

Suppliers' notes

Dick Brough, former operations manager at **Stewart & Stevenson Services, Inc.'s** Odessa, Texas, branch, has been transferred to Lubbock, Texas, as manager of the firm's sales and service facilities. **Royce Garner** succeeds Brough as Odessa operations manager.

E. D. Percifield, sales engineer at Mt. Pleasant, has been transferred to Lansing, Mich., by **Schlumberger Well Surveying Corporation.** At the same time, **C. R. Ferguson** moved from the South Rocky Mountain Division to Kimball, Neb. Ferguson also serves as a sales engineer. **C. W. Buchholz,** Pacific Coast Division engineer, transferred to Long Beach, Calif., as location manager, succeeding **G. D. Volkel** who has moved to the Pacific Coast Area as division engineer, and **W. J. Hickman,** operations engineer at the Houston headquarters, has been transferred to the Louisiana Gulf Coast Division and promoted to division engineer.

Paul A. Pitt has been elected vice president—engineering of **Solar Aircraft,** a subsidiary of **International Harvester Company.**

Roy F. Bennett has joined **Dresser Electronics, SIE Division,** as assistant to President **George A. Peck.**

John A. Boatman has been appointed general manager of **M-B Engine Company, Incorporated,** of New Orleans.

J. A. Boatman

S. S. Kidman

Seth S. Kidman has been appointed superintendent of the Baton Rouge plant of **Cal-Metal Pipe Corporation of Louisiana.**

Jim B. Gardner has been named regional sales supervisor and **Werner Hartman** named district superintendent for the Robstown-Three Rivers district in the South Texas area for **BJ Service, Inc.**

William E. Lennard has been appointed city representative of **U.S. Steel's Oil Well Supply** Division in Los Angeles. **T. H. Scheline** was appointed district representative, Wilson-Snyder Products, at Chicago.

Harry P. Woodson has been appointed galvanizing superintendent of **Continental-Emsco Co.'s** Houston plant.

Frank Carnahan has joined **A-Z International Tool Company** as a special milling supervisor and will work out of the Houston office. **Jimmy Lisle** has been named as in charge of A-Z's Louisiana Division with offices in Lafayette, and **Bobby McDonald** has joined A-Z as sales representative in the Houston office.

F. G. Williams, field engineer, Special Services of Liberal, Kan., for **Schlumberger Well Surveying Corporation,** has been named sales engineer. **J. V. Crues, senior** sales engineer in the Permian Basin Division, has moved to McCamey, Texas, as location manager. He succeeds **R. S. Beaty** who transferred to Tyler, Texas, as location manager. **C. F. Grice,** formerly Tyler location manager, has moved to the Houston headquarters offices as an operations engineer. **D. M. Quillin,** Permian Basin Division engineer, has transferred to the Mid-Continent Area to serve as assistant to the area manager. **E. S. Scholl,** division engineer, also has shifted to the Mid-Continent area, and **H. D. Babcock,** division engineer, also has moved to the Permian Basin Division from Kansas.

C. W. McComas has been appointed packer sales coordinator for **Otis Engineering Corporation.** McComas will headquarter at the home offices in Dallas. At the same time, **Wallace Robertson** was appointed gas lift manager, and he too will headquarter in Dallas.

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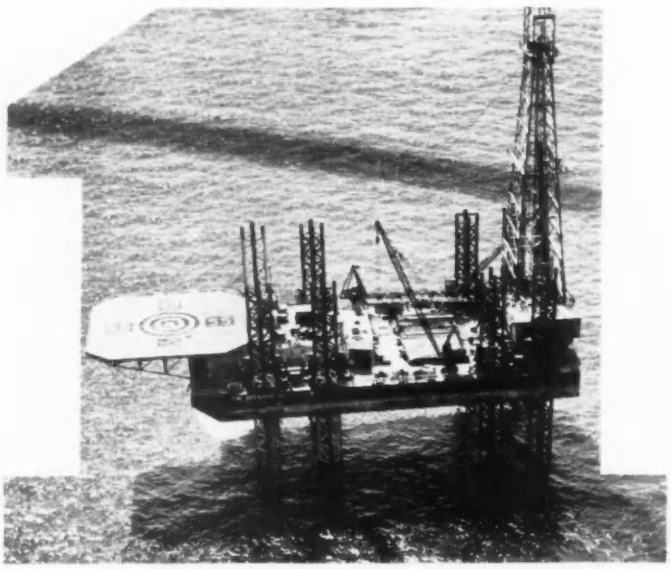

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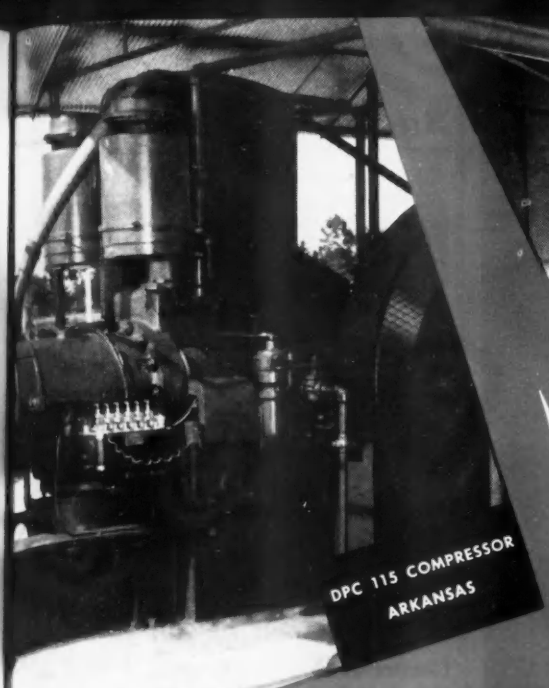
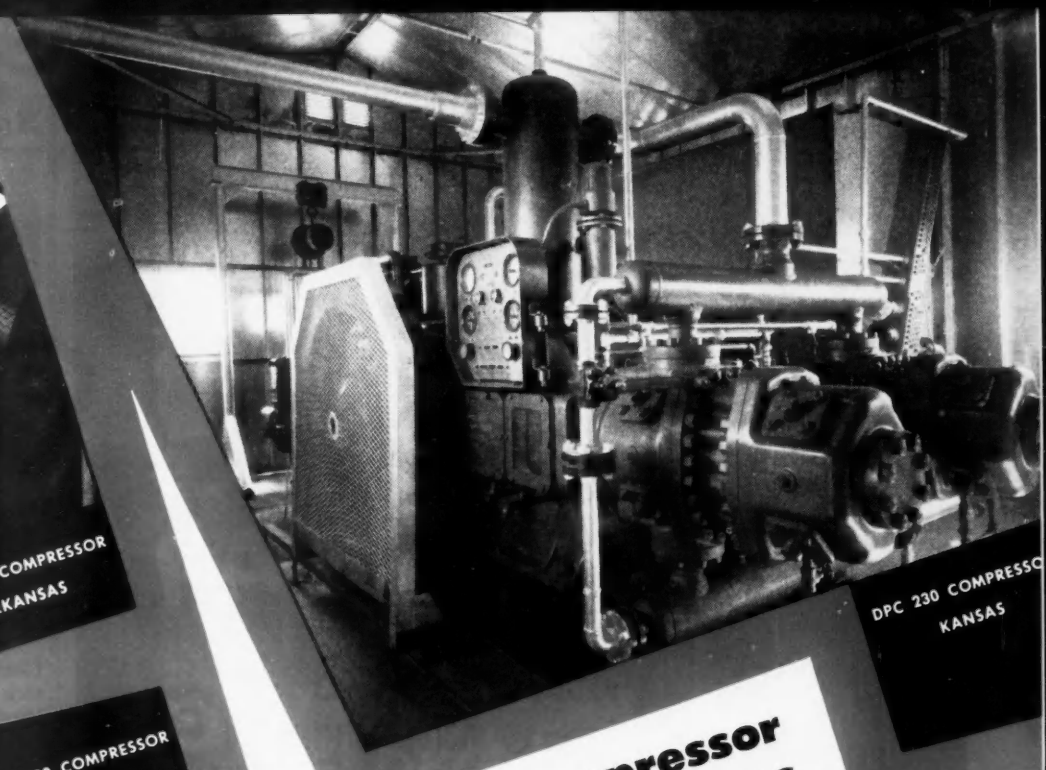
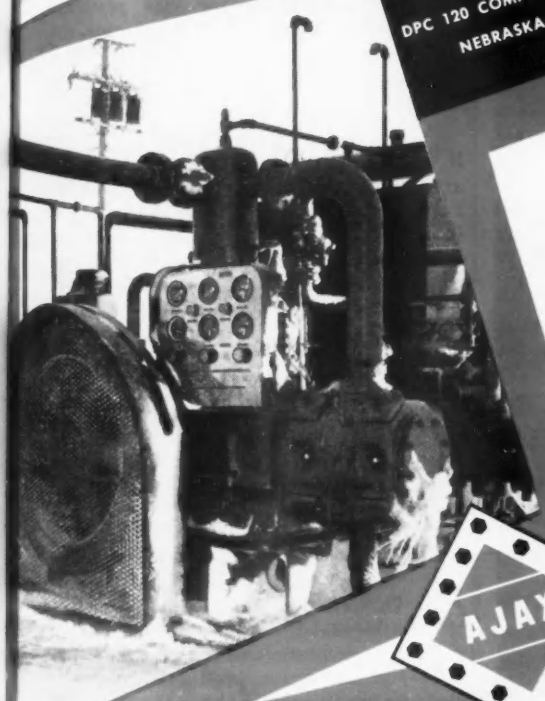


DPC 115 COMPRESSOR
ARKANSAS



DPC 230 COMPRESSOR
KANSAS



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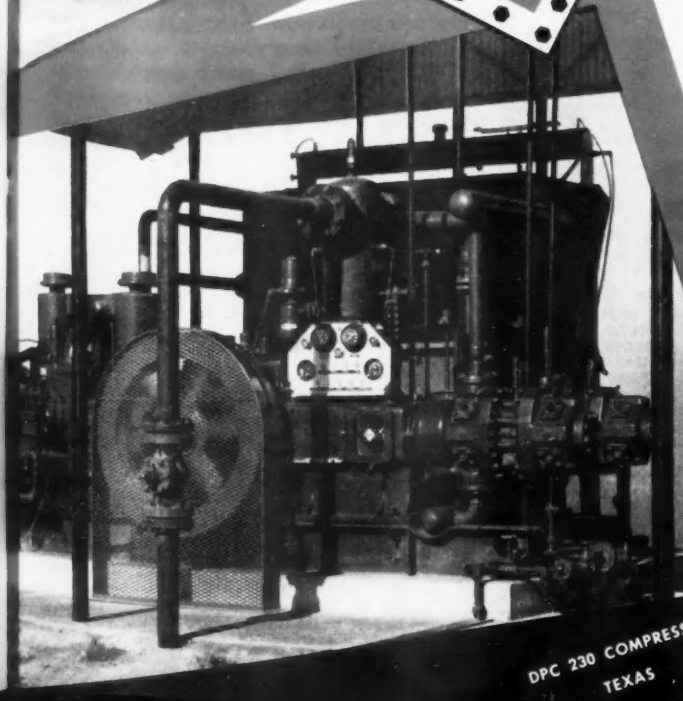
Oil Field Distributors

- The National Supply Co. — Pittsburgh, Pennsylvania
- Bethlehem Steel Co. — Supply Division, Tulsa, Oklahoma
- Mid-Continent Supply Co. — Fort Worth, Texas

AJAX



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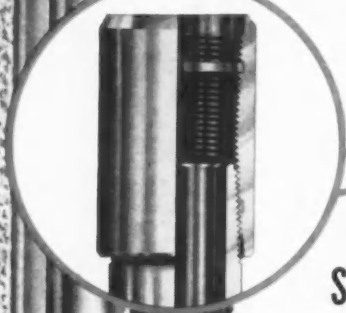
CALIFORNIA

SIMPLE SOLUTION FOR LEAKPROOF COUPLINGS IN TUBINGLESS COMPLETIONS*



Hardy - Griffin
GT-API
Modified Couplings
Seal For String's Life

Your savings from tubingless completions are protected by using the GT-API Modified Coupling with Teflon† seal rings. Leaks are eliminated. And, with no leaks at connections, you know that you're not faced with the possibility of an expensive squeeze job.

Whether your completion program calls for the conventional or the tubingless method, these GT-API Modified Couplings will give you leakproof joints. Where high pressure or resurgent shock may be a problem, the GT seal is particularly valuable.

HARDY-GRIFFIN ENGINEERING CORPORATION

HARDY-GRIFFIN
ENGINEERING CORPORATION
A Division of Atlas Bradford Company

Sales Office: 3600 Yoakum Blvd. • Phone: JA 6-1901 • Houston 6, Texas. Engineering and Plant: 14522 South Main St. • Phone: PA 9-9250 • Houston 35, Texas; 7707 Wallisville Road • Phone: OR 2-1701 • Houston, Texas; Odessa, Texas—Phone: EM 6-8241 • New Iberia, La.—Phone: EM 4-8666 • Oklahoma City, Okla.—Phone: CE 2-6665; Tulsa, Okla—Phone DI 3-6791.

*Also Conventional Completions

†Du Pont's Tetrafluoroethylene Resin

Suppliers' notes

Honored Upon Retirement

Chester S. Johnson (right), retiring as vice president, director and secretary of Hughes Tool Company after 43 years, was presented a testimonial scroll by M. E. Montrose, senior vice president and general manager. W. H. Siems, not shown, was elected to the board of directors and Raymond M. Holliday was elected secretary.

R. B. Park has been appointed sales manager, Industrial Rubber and Mechanical Packing for **Raybestos-Manhattan, Inc. R. B. Hazard,** previously vice president and sales manager Industrial Rubber and Mechanical Packings, has been appointed president-sales for these sales division of Raybestos-Manhattan. He was elected a director in 1960.

Len E. Brock has been named regulator sales and service engineer for the Permian Basin area for **Grove Valve and Regulator Company. Robert Churnside** has joined the Oakland-based manufacturer of production and pipe line valves and regulators as sales engineer.

John D. Craddock is the new manager of **Continental-Emsco Company's** Longview, Texas, branch store. Craddock was formerly a district production machinery specialist in Tyler, Texas. Other Continental-Emsco changes include **Earl D. Stanley,** former pump shop foreman in Pratt, Kan., is now the new D+B specialist there, and **Don L. Etter,** former field salesman in Wichita Falls, Texas, has been promoted to D+B specialist at the same location.

Peter T. Blinco has been promoted to special sales representative for **Tuboscope Company** and transferred to Midland, Texas.

George Roman and **Harry Landers** have been appointed sales representatives for the **Pete Sublett & Company.** Roman, co-author of the book, *"Macaroni Tubing,"* that is a guide in the industry, was formerly with Vinson Supply Company and Hydril Company. Landers, before joining the Sublett firm, was with Longhorn Machine Works.

Suppliers' notes

Carl J. **Hockenauer** has been appointed southwestern sales manager for **Auto Crane Company** of Tulsa.

Joe **Thompson** has been appointed division manager for **American Iron and Machine Works, Inc.,** with headquarters at Midland, Texas. The North and West Texas districts and the Dallas-Fort Worth area have been combined into this new division. Also, **David Beachum,** who formerly represented American Iron in Wichita Falls, Texas, and Canada, has rejoined them as special representative in the Dallas-Fort Worth area.

Bovaird Supply Re-Elects Directors and Officers

The Bovaird Supply Company re-elected all directors and officers of the firm at the recent annual stockholders meeting held in Tulsa.

The directors of the supply firm are D. D. Bovaird, president; R. G. Ayers, senior vice president; R. E. Batchelor, vice president and general manager; W. J. Bovaird, vice president sales; T. H. Trower, secretary-treasurer; A. E. Booth, independent operator, Bradford, Pa.; B. J. Williams, partner of Williams, Boesche & McDermott, and R. M. McMahan, former secretary of the company, but now retired.

BJ Service, Inc., Opens Second Oklahoma Station

BJ Service, Inc., has announced the opening of a new cementing service station in Kingfisher, Okla. This move follows the company's entry in Oklahoma cementing service in November 1959, when a completely up-to-date cementing operation was inaugurated in Woodward.

According to the announcement, this move into Kingfisher County is another step in BJ's continuing program of expanding cementing services into additional area.

Chester Chandler, moving from Chikasha, will be field supervisor in charge at Kingfisher. BJ Service, Inc., is a subsidiary of the diverisfied Borg-Warner Corporation. The company maintains general offices in Forth Worth and Long Beach, Calif.

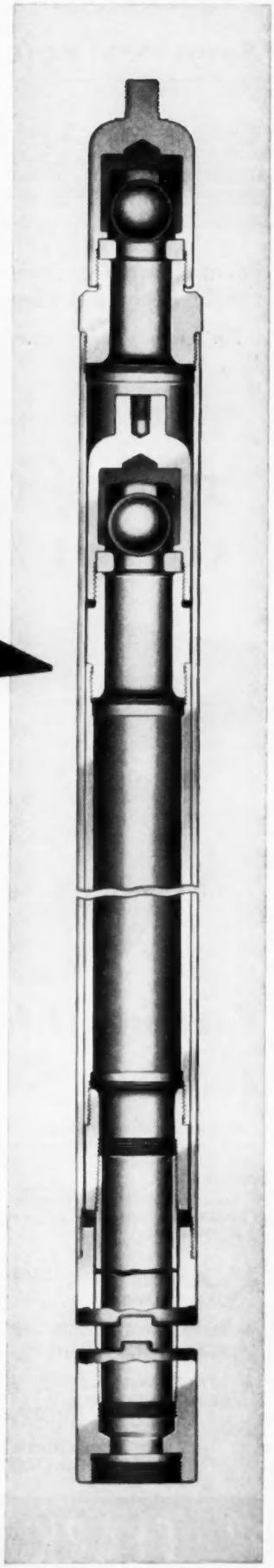
Eastman Oil Well Acquires McGaffey-Taylor Corporation

Eastman Oil Well Survey Company has announced the acquisition of the McGaffey-Taylor Corporation, a leading West Coast oil well service company. The purchase was accomplished through exchange of an undisclosed amount of stock.

McGaffey-Taylor, with sales-service offices in Long Beach, Ventura, Bakersfield and Avenal, Calif., is a 28-year old company specializing in oil well squeeze, washing and cementing tools. The company designs and manufactures a com-

*Designed for Your Waterflood**

*WITH THIS PACIFIC INSERT ROD PLUNGER PUMP YOU GET VOLUME *plus*



1 A precision insert rod pump of 4½" O.D. x 3¾" I.D. built to Pacific standards.

2 A specifically designed pump for pumping large volumes of fluid efficiently **at any speed**—fast or slow—with a conventional pumping unit installation.

3 A pump that will seat in a regular production casing packer and may be operated in 5" casing (or larger) thereby eliminating tubing.

4 A pump ideally suited for pumping water supply wells in the range of 2000 to 3000 barrels of fluid per day for water flooding operations.

5 A pump equipped with Pacific Pacilite chrome plungers and the latest design rubber lined cages for long trouble-free operation.

Ask your Pacific field salesman for more details or write:

PACIFIC PUMPS, INC.
A DIVISION OF DRESSER INDUSTRIES, INC.
HUNTINGTON PARK, CALIFORNIA

Mid-Continent:
P. O. Box 5428
Tulsa 16, Oklahoma

Canadian Division:
9707 • 63rd Avenue
Edmonton, Alberta

ONE OF THE DRESSER INDUSTRIES
PACIFIC®
DW-18

plete line of unique engineered down-hole tools and maintains crews of trained personnel to service oil drilling rigs and re-drilling of existing wells throughout California.

Porta-Kamp Occupying Newly Expanded Plant

Porta-Kamp Manufacturing Company, Inc., has moved into expanded plant facilities in Houston.

The new facilities have over 28,000 square feet which includes offices and a display room. With the new facilities, Porta-Kamp has announced that they are in a position to mass produce any of their units on an assembly line.

Nitrogen Engineering Co. Opens Houston Headquarters

Nitrogen Engineering Service Company, recently organized in Houston, offers services on the use of high-pressure nitrogen in oil and gas wells.

The firm has two service trucks at the present, expects a third in the near future. They can pressure to 8,000 psi and the capacity of each truck is 101,000 scf. Trucks can be manifolded for greater pumping rates and volumes as required by the job. The new firm has available technical data on its services on the use of nitrogen and price lists.

Continental-Emsco Announces Five Companies as Distributors

Continental-Emsco Company's Industrial Sales Division has recently announced the addition of five companies to distribute its line of swivel joints and loading arms. This new addition increases the total number of distributors to 19 throughout the United States and Canada.

The five new companies named as distributors include: Gary Sales Company, Detroit; Midway Supply Company, Inc., Jackson, Miss.; Mechanical and Electrical Equipment Company, Tulsa; Calvert-Conel Company, Cleveland, and Keystone Pipe and Supply Company, Milwaukee.

Wickersham and Company Represents Daniel Orifice

William B. Wickersham and Company has been named the executive sales representative in New England by the Daniel Orifice Fitting Company of Houston. Wickersham and Company's headquarters are located in West Newton, Mass.

Wickersham will handle sales and service of Daniel products for flow measurement in Maine, New Hampshire, Vermont, Connecticut, Rhode Island and Massachusetts, except for Berkshire County.

William B. Wickersham heads the company and is assisted by Lawton Bourn.

Iron Incorporated Newly Formed in Oklahoma City

A new firm, Iron Incorporated, designed to engage in brokerage of all sorts of oil field equipment, but specializing in well servicing, has been formed in Oklahoma City. Carl Joyner formed the new firm and will act as president.

Offices of Iron Incorporated are located in the Oil and Gas Building, Oklahoma City.

Continental-Emsco Opens Portable Subsurface Shop

Continental-Emsco Company has opened a new portable yet complete subsurface pump shop at Forsan, Texas, as a "satellite" operation of its Snyder, Texas, store.

Provided with tools and equipment of the latest design, the shop is capable of repairing all types of bottom hole pumps and is completely stocked with new D+B pumps and parts.

R. L. Pebworth, district manager at Abilene, Texas, has announced the appointment of A. L. Hawkins as pump shop foreman and Robert L. Hicks as D+B Specialist.

The *New* PROVEN WAY to get the...

BEST CEMENT JOB

SPIN-O-LIZER CEMENT SPINNERS

Manufactured for All Sizes of A. P. I. CASING

SPIN-O-LIZERS take the doubt out of your cementing. Cement Bond Logs and Temperature Surveys have proven on well after well that SPIN-O-LIZERS give a more thorough and uniform cement job.

Avoid damaging your formation by using SPIN-O-LIZERS to eliminate the possibility of having to put a squeeze job on your formation.

★ ELIMINATES CHANNELING
★ REDUCES CONTAMINATION
★ SPACES MULTIPLE CASING STRINGS
★ CENTERS CASING
★ ACTS AS STOP COLLAR
★ MADE OF TENZALOY

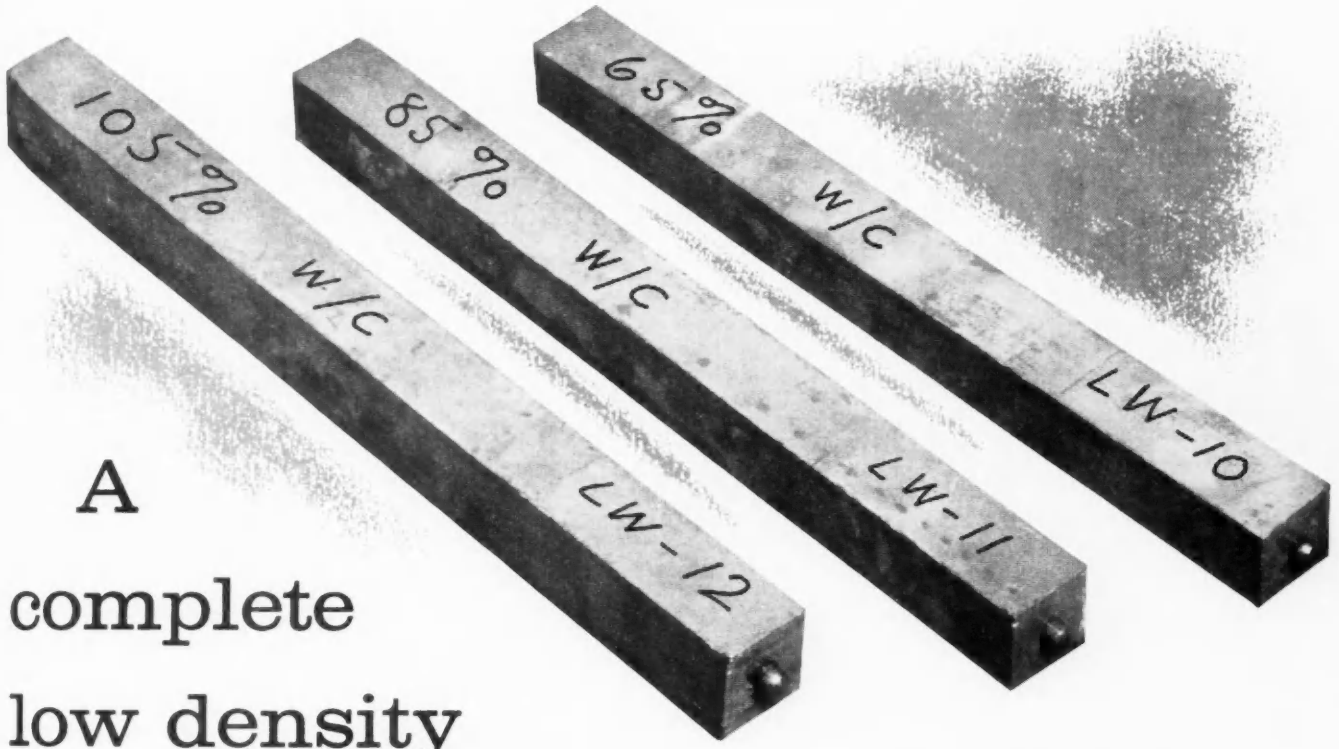
Contact your favorite supply store, Clark Oil Tools or their representatives for SPIN-O-LIZERS, Clark Scratchers, Centralizers, and Stop Collars.

CLARK OIL TOOLS

PH. 767-2440, WICHITA FALLS, TEXAS, P. O. BOX 238

REPRESENTATIVES
Roy Manning—Wichita Falls, Texas
Bill Whitaker—Throckmorton, Texas
Kenneth Clark—Alice, Texas
Owen Marsh—Tulsa, Okla.
Ben Bolding—Guymon, Okla.
B & R Service Co.—Farmington, N. M.
Dave Crancer—St. Louis, Mo.
John Raymond—Hutchinson, Kan.
Globe Oil Well Cementing Inc. Great Bend, Plainville, Hill City, and Kiowa, Kansas.

Trinity LITE-WATE



A complete low density cement that is

SULPHATE RESISTANT

Shown above are three unretouched photos of test bars produced from TRINITY LITE-WATE neat slurry that were immersed in a 5% sodium sulfate–5% sodium chloride solution for a period of more than one year. These bars are completely sound and show no expansion.

In the range of lightweight cement slurries, TRINITY LITE-WATE produces a slurry which is:

1. Sulfate resistant for lasting casing protection.
2. Remains impervious to migrating fluids.
3. Light enough to circulate.
4. Strong enough for any casing seat.
5. Strong enough to permit hydraulic fracturing.
6. Easy to mix, easy to pump.

For TRINITY LITE-WATE cement call your service company.

For complete Laboratory Data call your local Trinity Representative or write Dallas Office, P. O. Box 2698 or phone RIverside 2-8111.

75 lb. Dry Volume per cubic foot

TRINITY

PORTLAND CEMENT DIVISION

GENERAL PORTLAND CEMENT COMPANY

GPCC

DALLAS·FT.WORTH·HOUSTON

Delta now serves

aruba

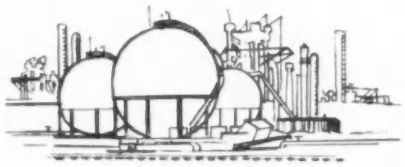
N. A.

DC-7B service between New Orleans and

Montego Bay
Aruba
Caracas

Deluxe Royal Service and Royal Scot Tourist on every flight—complimentary meals on both. Beverage service available.

Direct connections at New Orleans to and from Chicago • St. Louis • Texas and California.



DELTA AIR LINES

See your Travel Agent or call Delta

SQUEAKS

From the Bull Wheel

A Chip Off the Ole——

A noted sculptor had just finished an enormous statue of an elephant and proudly unveiled it for some friends.

"What did you use as a model?" asked one.

"I didn't have one."

"But how could you get such a perfect likeness without a model?" insisted the friend.

"Oh," was the airy reply, "I just kept chipping off the pieces that didn't look like an elephant."

The Little Woman

The weary husband was met at the door with sad news. "We'll have to go out for dinner," his wife said cheerily. "I couldn't prepare anything because the electricity went off."

"Electricity?" the husband growled. "We have a gas range."

"I know," the wife went on, "but we have an electric can opener."

Great White Hunter

The hunting party was hopelessly lost and the hunters turned angrily to their guide. "I thought you said you were the best guide in Maine!" one of them snapped.

"I am," protested the guide, "but I think we're in Canada now."

Those Coupon Kids

A bride was showing a friend the kitchen of her new, seven-room house. "We furnished the kitchen with soap coupons," the bride said.

"With soap coupons!" the friend exclaimed. "What about the other six rooms?"

"Oh, those," the bride replied, "they're filled with soap."

Is This Call Necessary

The sheriff for a small town was also a veterinarian. Late one night the telephone rang and his wife got up to answer it. "Is Mr. Shortall there?" asked an agitated voice.

"Do you require my husband's services as a sheriff or as a veterinarian?"

"Both," came the reply. "We can't get our dog's mouth open and there's a burglar's leg in it."

A Woman's Prerogative

A woman called for jury duty refused to serve because she didn't believe in capital punishment. Trying to persuade her, the judge explained: "This is merely a case where a wife is suing her husband because she gave him $1,000 to pay down on a fur coat and he lost the money in a poker game."

"I'll serve," she said. "I could be wrong about capital punishment."

"Oh, er—give me a pulsation dampener for my mud pump."

Ain't It the Truth

In these days of low-cut gowns, tight-fitting waists and sheer stockings, it takes will power for a man to look a woman in the eye.

Tsch, Tsch,—Such Language

A Boston spinster was shocked at language two telephone repairmen used while working on some wires. She reported the incident and immediately the manager asked the men what they had said.

"Me and Spike were on this job. I was up on the pole and accidentally let some hot lead fall on Spike—and it went down his neck. Then Spike looked up at me and said: "Really, Harry, you must be more careful."

What Can You Expect

The recently married young thing was buying a chicken for hubby's dinner.

"Wanna pullet?" asked the butcher, looking over his stock.

"Oh, no, I'll just carry it," replied the bride cheerfully.

Not Like the Freeways

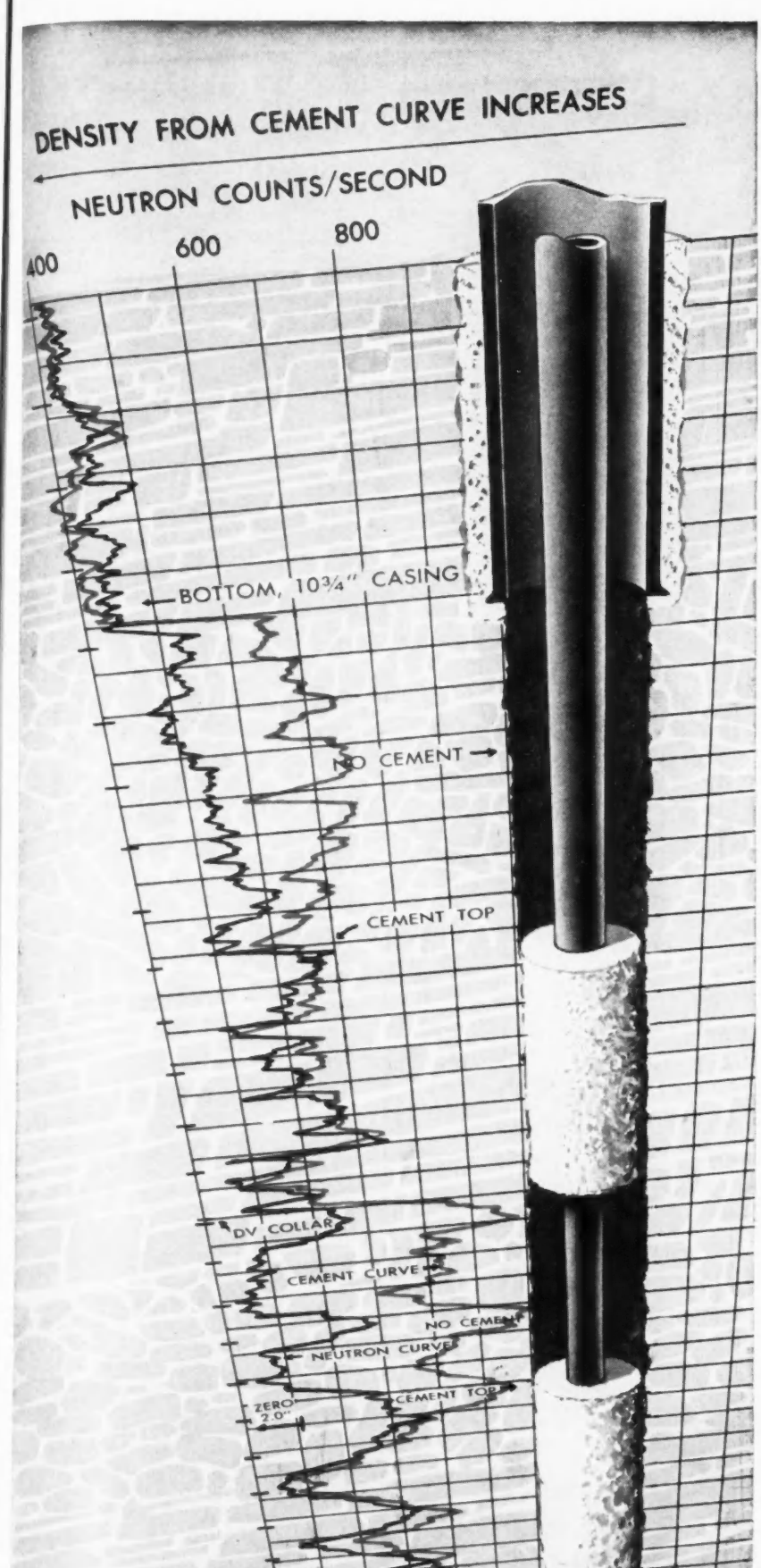
Riding Instructor: "What kind of saddle do you want? One with a horn or one without?"

Dude: "Without, I guess. There doesn't seem to be much traffic around here."

Shocking Courtesy

"How did you happen to hit the pedestrian?" the policeman asked.

"But I didn't hit him," declared the motorist. "I came to the stop sign and stopped. I motioned to him to go across and he fainted!"



McCullough

NUCLEAR CEMENT LOG

with Scintillometer ®

—lets you SEE

your cement column

Here's an improved cement locating log that accurately "pictures" the cement column in your well. It will identify the presence of the cement column, confirm the quality of the job, locate cement tops, indicate uncemented sections and possibly detect channeling. It is equally effective in new wells or in old wells of any age.

The McCullough Cement Log records a curve which reflects the density of the material behind the casing. Thus, the location and characteristics of the cement column, when it differs in density from the displaced fluid, can accurately be determined.

This log is usually run on the same trip into the well with other nuclear well surveys, thus requiring no extra rig-time. In fact, the cement curve can be one of six separate logs, all revealing different down-hole information, that may be obtained on a single run without coming out of the hole. Also, it is very economical, price-wise, when run in combination with other nuclear logs.

Proved thoroughly effective on hundreds of jobs, the McCullough Cement Log is being adopted as standard procedure for determining the effectiveness of the primary cement job, checking squeeze jobs and for use in future workover or remedial operations.

The Cement Log shown at the left is made up of sections of an actual log run in 5½" OD casing from 3800' to surface. All information shown is exactly as it appeared on the original log.

McCullough

TOOL COMPANY

Los Angeles • Houston • Edmonton

Cable Address: **MACTOOL**

Entering its tenth year of service to the industries that produce and distribute natural gas, Transco points with pride to the stability of markets it affords producers, and to the economies of transmission it affords customers. TRANSCO—the pipeline carrying natural gas to the markets where the most people are.

TRANSCO 10TH ANNIVERSARY

TRANSCONTINENTAL GAS PIPE LINE CORPORATION

Heroic Indeed!

Diary of a young lady taking her first ocean voyage:

Monday: I feel highly honored for being placed at the captain's table.

Tuesday: I was on the bridge with the captain. He seems to like me.

Wednesday: The captain made proposals unbecoming to an officer and a gentleman.

Thursday: The captain threatened to sink the ship unless I agreed to his proposals.

Friday: I saved 600 lives today.

TV or Not TV?

She: "I saw a Texas Ranger carrying two rifles."

He: "That's nothing. I saw a cowgirl packing a pair of 38's."

Mother's Sensitive Darling

Mother (speaking to school teacher): My Harold is a very sensitive boy. "If you need to punish him, just slap the boy in the next seat. This will frighten Harold."

The Expendable Type

A young teacher was hired as a substitute for a friend who was taking a week off for a honeymoon. Later at a party, someone started to introduce her to the groom.

"Oh," he answered brightly, "I know Miss Smith. She substituted for my wife on our honeymoon."

And So Goes Life

One of the greatest mysteries of life is how the boy you were sure wasn't good enough to marry your daughter, can be the father of the smartest grandchild in the world.

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WORLD OIL's annual Editorial Index, covering all the issues published during 1960, is now available to all WORLD OIL readers. Bound in convenient pamphlet form, this handy and useful index will be sent FREE to all subscribers requesting copies. What special issue or article did you forget to save? Well, no need for worry, the 1960 Editorial Index refreshes your memory.

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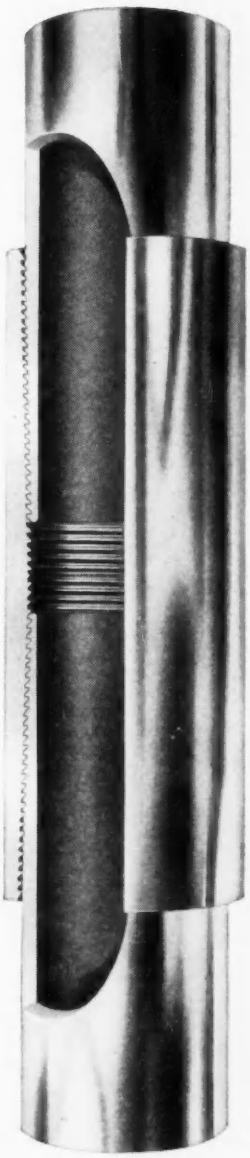
Something new
in the oil country



USS National Buttress-Thread Tubing

National Tube, developer of Buttress-Thread Casing, now introduces Buttress-Thread Tubing.

This new joint has tensile strength comparable to that of the body of the tubing. Since there is no upset, you get maximum hole clearance and less interference when running. Rugged, flat-crested threads have good stabbing characteristics, better resistance to joint damage and faster make-up. Buttress-Thread Tubing has extended life in service because it can be threaded in the field at authorized machine shops. Tin-plated coupling threads offer you gas-tight joints and reduce your make-up torque. For complete information on Buttress-Thread Tubing, write or call National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

USS and National are registered trademarks

National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York

This mark tells you a product is made of modern, dependable Steel.

COUPLINGS BY Wheeling

LINE PIPE COUPLINGS A. P. I.
⅛" to 16"—Seamless,
PLAIN TUBING COUPLINGS A. P. I.
1" to 4"—Seamless
EXTERNAL UPSET TUBING COUPLINGS A. P. I.
¾" to 4"—Seamless
CASING COUPLINGS A. P. I.
4½" to 13⅜"—Long or Short
HYDRAULIC COUPLINGS
⅛" to 4"—Seamless
REAMED AND DRIFTED A. I. S. I.
1" to 12"—Seamless
DRIVE PIPE COUPLINGS
6" to 12"—Seamless
PIPE NIPPLES
All Sizes and Types
STEEL BUSHINGS AND PLUGS
Merchant and High Pressure

WHEELING MACHINE PRODUCTS CO.

Wheeling, West Virginia

West Coast Factory: Woodlake, California

OILFIELD TRANSPORTATION EQUIPMENT

OILFIELD TRUCK AND FLOAT

Thornycroft Sandmaster 252" wheel base Oilfield Truck. Hands-England full Oilfield Body. 60,000 lb. winch, heavy duty gin poles, winch operated gin pole risers and folding SAE king pin.

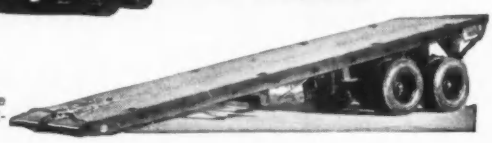
Hands-England 75,000 lb. capacity, tandem axle Oilfield Float 30' 0" long and 9' 6" wide, folding support legs and inverted 36" fifth wheel.

Truck and Float on Michelin 18.00 x 25. Sahara "X" sand tires.

OILFIELD FLOAT

Hands-England 75,000 lb. capacity tandem axle Oilfield Float 30' 0" long and 8' 6" wide, folding support legs and inverted 36" fifth wheel.

Float on 11.00 x 20 — 14-ply tires.

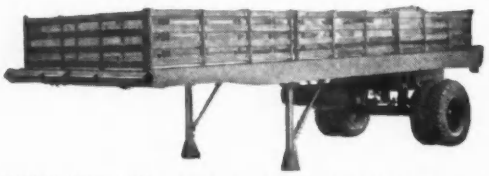


OILFIELD TRUCK AND FLOAT

Scammel Constructor 261" wheel base Oilfield Truck.

Hands-England 75,000 lb. capacity tandem axle Oilfield Float 30' 0" long and 9' 6" wide folding support legs and inverted 36" fifth wheel.

Truck and Float on 14.00 x 20 — 18-ply tires.



OILFIELD FLOAT

Hands-England 25,000 lb. capacity single axle Oilfield Float 24' 0" long and 8' 0" wide, folding support legs and SAE king pin 11.00 x 20 — 12-ply tires. Steel stake sides.

HANDS-ENGLAND OILFIELD EQUIPMENT LTD. Works Road, Letchworth, Herts., England

Telephone: Letchworth 600 Telegrams: Oil, Letchworth, Cables: Oil, Letchworth, England

BMJ

WORLD OIL

"She worships the ground he drills on."

This Modern Age

When adults act like children, they're silly. When children act like adults, they're delinquent.

A Fair Question

"Where you from?"

"Washington."

"Washington?" said the farmer. "Which Washington—tax-eatin' or tax-payin'?"

An Old, But Sensible Proverb

You should hang on to your money, if you can. It may become valuable again some day.

Well?

Message on a post card a psychiatrist received from a vacationing patient: "Having a wonderful time. Why?"

Smuggler But No Dope

While visiting America, a lovely French maiden discovered both her visa and her money had vanished. She was in great despair until an enterprising young sailor came to her rescue.

"My ship is sailing tonight," he said. "I'll smuggle you aboard, hide you in the hold and provide you with food and blankets. All it will cost you is a little affection."

She consented and he carried out his promise, visiting her several times daily. This went on for several weeks until one day the captain of the ship discovered the sailor paying her a visit. After the sailor had gone, he confronted the girl and upon hearing her sad story mused, "I admire the young seaman's ingenuity. However, I feel it's only fair that I inform you this is the Staten Island ferry."

Over Extravagant

A lady busily engaged in washing her upstairs windows leaned out too far and fell, landing squarely in a garbage can. A passing Chinese gentleman looked, shrugged, and said, "Americans, velly wasteful. Woman good for 10 years yet."